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Editorial: The Governance of the International Code of Nomenclature—My Slow Learning Experience

Leslie R. Landrum, Editor i

Vascular Plants of Arizona: Phrymaceae

Kimberly Hansen, Elizabeth Johnson, Kirstin Olmon Phillips, Joseph Talboom, and Tina Ayers 1

Vascular Plants of Arizona: Acanthaceae

Thomas F. Daniel 22

Vascular Plants of Arizona: Cucurbitaceae

Mary Butterwick 55

New Records for the Flora of Arizona

Katherine Darrow and Elizabeth Makings 86

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Canotia is named for *Canotia holacantha* Torr. (Celastraceae), a spiny shrub or small tree nearly endemic to Arizona. Illustration of *Canotia holacantha* on cover by Alandon Joe.

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EDITORIAL: THE GOVERNANCE OF THE INTERNATIONAL CODE OF NOMENCLATURE—MY SLOW LEARNING EXPERIENCE.

The Code of Nomenclature for Algae, Fungi, and Plants (formerly the International Code of Botanical Nomenclature) is an important document of international law (http://www.iapt-taxon.org/nomen/main.php). It tells us how the scientific names of plants, new and old, should be applied—what the correct name of a plant is given a particular taxonomy. One might think that the Code is governed by some international institution or organization such as the United Nations or the International Association for Plant Taxonomy (IAPT), but it is not. It is loosely associated with International Botanical Congresses, a tradition over 100 years old. In between congresses, a series of committees makes decisions about nomenclature and these are then nearly always approved at the next International Botanical Congress (IBC). I did not clearly realize how the governance of nomenclature functioned until recently, about 48 years after I was first introduced to the concept of botanical nomenclature.

My education in botanical nomenclature began in 1968 when I took "Plant Taxonomy" from my revered Professor John L. Morrison at the New York State College of Forestry in Syracuse, New York, USA. One lesson I was supposed to learn about botanical nomenclature in Morrison's class (but didn't really learn until after the final exam) was that in practice it is a peaceful form of international cooperation in which all the participants agree that they will follow certain rules about how plants are named, but there is no one imposing those rules. It is a kind of peer-enforced utopia for botanists in which everyone cooperates towards a common goal. I would later learn that while the concept was a wonderful idea, it was not quite true.

In 1974, I was a graduate student at the University of Michigan and took "Advanced Plant Taxonomy" from an equally esteemed professor, Rogers McVaugh. One thing that I should have learned in McVaugh's class but I did not, maybe because I just didn't listen, is that the Code has Principles. I did not learn that fact until taking a "qualifying examination" for graduate students. Now I think "the Principles" represent the most important part of the Code.

The Code has three **Divisions**: **I, II,** and **III**. **Division I** states the Principles, which are brief but very enlightening. They can also be a guide for most nomenclatural problems. I reproduce them here:

DIVISION I. PRINCIPLES

Principle I

The nomenclature of algae, fungi, and plants is independent of zoological and bacteriological nomenclature. This *Code* applies equally to names of taxonomic groups treated as algae, fungi, or plants, whether or not these groups were originally so treated.

Principle II

The application of names of taxonomic groups is determined by means of nomenclatural types.

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Principle III

The nomenclature of a taxonomic group is based upon priority of publication.

Principle IV

Each taxonomic group with a partieular circumscription, position, and rank can bear only one correct name, the earliest that is in accordance with the rules, except in specified cases.

Principle V

Scientific names of taxonomic groups are treated as Latin regardless of their derivation.

Principle VI

The rules of nomenclature are retroactive unless expressly limited.

Division II, the meat of the Code, is a collection of rules telling people how plants are named and can be quite complicated and difficult to understand. The rules often contradict the Principles, for instance, by allowing for the "conservation" of a name that does not have priority over one that does. In this sense conservation means overriding the principles of Priority or Types when another name or type may be more desirable for "nomenclatural stability." Originally, conservation was restricted to generic names but it has grown to include species names.

Division III consists of the rules for changing the Code. At present, changing the Code happens at an International Botanical Congress (IBC), gatherings that occur every six years at different locations around the globe. In order to participate, one must physically be present at the Nomenclature Section, a week long meeting before the rest of the IBC, at which taxonomists from around the world consider proposals to change the Code.

Division II, the rules for naming plants, have changed a lot over the years, but Divisions I and III have changed very little, if at all, since they were first written in the 1950s.

Here is an example of how Division II has changed. Before January 1, 1935 it was possible to describe new taxa in any language. Between January 1, 1935 and December 31, 2011 it was necessary to describe new taxa in Latin. From January 1, 2012 onward it is possible to describe new taxa in Latin or English.

There have been many other changes and some changes are logical with the changes in technology—it is now possible to publish new taxa electronically in PDF files, for instance. Other changes seem to reflect changes in the general opinion among taxonomists, for example, the ability to conserve species names.

The next stage in my nomenclature education came from attending International Botanical Congresses. In 1999 I went to my first in Saint Louis, Missouri, USA. The Nomenclature Section was held at the Missouri Botanical Garden. Some very contentious issues were discussed and voted upon, namely whether or not there would be lists of names that could be used and other names that would be excluded and whether or not names would have to be registered with some world authority in order to be validly published. Both those ideas failed. If they had

passed, many people thought it would have been a disaster, while others thought they were wonderful ideas that would increase the stability of botanical nomenclature.

Then in 2005 I went to another International Botanical Congress in Vienna, Austria. Again there were some contentious issues, but this time the most important was whether we would approve the action of a committee that had changed the type species of *Acacia*. The majority of the committee's 15 members believed that because phylogenetic studies had shown that the genus *Acacia* was polyphyletic, and should be divided into a few separate genera, then the name *Acacia* should go with the clade with the most species, a clade that mainly grows in Australia. The type species would be changed to an Australian species. The principles II and III of the Code would have indicated that the name *Acacia* should stay with the type species in Africa and the name *Acacia* would have continued to be used mainly in Africa, North and South America, and Asia (as it had been), and numerous Australian species of *Acacia* would have been changed to *Rhacosperma*. There was a lot of discussion and people were adamant on both sides. Finally, on the last day in the last hours of the Nomenclature Section, we voted. Those who wanted to keep the type with the African species, in accordance with the Principles of the Code, were in the majority (about 54%), but the people in charge of the meeting told us we needed 60% to overturn the committee's decision. This was a great disappointment and surprise to many of us. It seemed to some of us that rules were being made up as they were needed. There is nothing in the Code about this 60% rule to overturn a committee decision.

The next International Botanical Congress was in Melbourne, Australia in 2011. I did not attend that meeting, but I made some proposals that I thought would have made the process of changing the Code more transparent and democratic (Landrum 2011). None of those proposals passed but two special committees, one on bylaws (Division III) and one on Institutional Votes, have been set up and are making new proposals that will be discussed at the next International Botanical Congress in China in 2017 (Knapp et al. 2016a, 2016b). I have had the honor of participating on the first committee.

One problem is that these meetings on nomenclature at an IBC are by necessity held in one city of one country and that locality changes every six years. As they say in the real estate business, "location, location, location." Where a meeting is held matters because of the difficulty or ease of attending a meeting. If the St. Louis congress had been held in Europe, it is likely that the result would have been different. And if the Vienna congress had been in Africa or Latin America, the result would surely have been different. So far, no International Botanical Congress has ever been held in Africa or Latin America.

Botanical nomenclature is part of International Law. Plants must have names to be part of international commerce, agriculture, horticulture, medicine, conservation, etc. Governments generally accept the names we botanists tell them are correct. But who decides how those names should be applied? Is it a democratic process? Should nomenclature be left to experts? Who should participate and how should they participate? At present the process is rather complicated and not especially democratic. I explain the three ways of voting below: **Mail Votes, Institutional Votes**, and **Personal Votes.**

First, anyone can make a proposal to change the Code by sending a proposal to the editors of TAXON (http://www.iapt-taxon.org/index_layer.php?page=s_taxon), the journal of the International Association for Plant Taxonomy (IAPT). Generally the proposal will be published and people around the world can read it and consider if it is a good idea or not.

Mail Votes. Then before an IBC a ballot on all the proposals is sent to all the members of IAPT (as well as members of the nomenclatural committees and to persons who propose changes in the Code, even if they are not members of IAPT). Recipients of the ballot can express their opinion in a "Mail Vote." The "Mail Vote" or "Guide Vote" has not been given much weight in the past. When 75% or more of the ballots are against a proposal it is generally rejected before an IBC. But even then it may be considered if there are a few supporters present at the IBC. On the other hand, if the mail vote is strongly against a proposal, for instance 60% against, that fact may influence the outcome at an IBC.

Institutional Votes. Herbaria around the world are given "Institutional Votes" that can be taken to an IBC by someone attending the Nomenclature Section. One proposed justification for Institutional Votes has been to diminish the importance of the location of a meeting (Demissew & Funk 2013). If no one from your institution can go, you can send your vote with a person who is able to go or you can send it to the "Bureau of Nomenclature" (i.e., the rapporteur-général mentioned below and others officiating the Nomenclature Section) saying your institution wants to vote a certain way on a certain proposal. Any individual can carry up to 14 Institutional Votes and will have a personal vote as well. A committee assigns the Institutional Votes, with larger institutions getting more. Presently the committee assigning these votes is the "Bureau of Nomenclature of the International Botanical Congress," but that is expected to change to a special committee in charge of Institutional Votes.

Allocation of Institutional Votes can vary widely. The country of Chile, for example, has two Institutional Votes: one for SGO (Museo Nacional de Historia Natural) and one for CONC (Herbario de la Universidad de Concepción). The large herbaria of Europe and North America have as many as 7 votes each!

Luckily, if your institution has no vote you can request an Institutional Vote from the leading officer of Nomenclature, the rapporteur-général (at present Dr. Nicholas J. Turland, n.turland@bgbm.org) or you may request a vote from the Special Committee on Institutional Votes that was established at the last IBC in Melbourne (http://www.iapt-taxon.org/index_layer.php?page=s_institutional_votes). Smaller herbaria around the world should be asking for votes. The first step is registering your herbarium in Index Herbariorum (http://sweetgum.nybg.org/science/ih/), which lists all the active herbaria of the world. By being part of Index Herbariorum you demonstrate that your institution is part of the world community of plant taxonomists. It is important to demonstrate also the level of taxonomic activity (e.g. number of active staff, size of collections, visitors, recent taxonomic publications by staff) at your institution. The Special Committee on Institutional Votes is already busy with many requests so it would be best to make a request soon.

Personal Votes. The most direct way to participate is to attend the IBC, pay registration for at least one day, and participate in the week-long Nomenclature Section using your Personal Vote. The next IBC will be in Shenzhen, China and the nomenclature Section will take place from July 23 to 29, 2017. Unfortunately it is an expensive proposition to attend and that makes the process of participating in this form of international government difficult. It is left to a few dedicated people who can afford to go. Sometimes a few people, no matter how well meaning, may have ideas that differ widely from people who are unable to attend.

Some of us believe that in this day of the internet it should be possible for people to attend the IBC Nomenclature Section virtually. It might not be possible to discuss an issue easily but one could follow the discussion and make an informed choice of how to vote. It is my hope that this will happen by 2023 or 2029 at least!

"Demokratia" from Greek: *demos*, the people; and *kratia*, power or rule. Democracy only works if people (in this case botanists) understand the process and participate. I hope some of you will try to participate in one way or another in the governance of the International Code of Nomenclature, either by casting a **Mail Vote**, obtaining an **Institutional Vote** for your institution to be sent to Shenzhen, China, or perhaps even attending the Nomenclature Section yourself and casting your own **Personal Vote**.

Leslie R. Landrum
Editor

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PHRYMACEAE LOPSEED FAMILY

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Annual or perennial herbs. LEAVES simple, opposite, with or without glandular hairs; stipules absent. INFLORESCENCE racemose or of solitary axillary flowers. FLOWERS perfect, actinomorphic or zygomorphic (weakly to strongly bilabiate), ebracteate, hypogynous; calyx synsepalous, the lobes 5, equal or unequal, shorter than the tube; corolla sympetalous, with two lips, the upper lip 2-lobed, external in bud, the lower lip 3-lobed, the lower side of the throat with two elevated longitudinal ridges forming a palate, this sometimes partially or completely closing the orifice, usually bearded; stamens 2–4, when 4, didynamous; anthers with two well-developed sacs, the sacs confluent at the apex and more or less divaricate at the base; ovary with 2 fused carpels, superior, placentation axile, parietal, or basal; style solitary, stigmas 2-lobed, the lobes distinct or united. FRUIT a 2-valved, loculicidal capsule sometimes also splitting at the septum dividing the placentae. —ca. 13 genera, ca. 188 spp., worldwide, most abundant in western N. Amer.

The family includes economically important ornamental species in the genera *Mazus, Mimulus*, and *Erythranthe*. Recent phylogenetic studies support a close relationship between *Mimulus* (and relatives) and *Phryma* of the formerly monotypic family Phrymaceae (Beardsley & Olmstead 2002, Tank et al. 2006). The genus *Mimulus* has been dismantled into three distinct lineages (Barker et al. 2012). The Arizona species formally treated as *Mimulus* species are here treated as members of the genera *Mimetanthe, Erythranthe* or *Diplacus*. The genera are distinguished from each other in the key below.

1. Flowers sessile to subsessile; corollas persistent in fruit; pedicels usually shorter than calyces ..... ***Diplacus***
1' Flowers long-pedicellate; corollas deciduous in fruit; pedicels usually longer than calyces.
   2. Calyx not strongly angled, strongly zygomorphic; capsule glandular; fertile stamens 2(–4); placentation parietal ..... ***Mimetanthe***
   2' Calyx usually 5-angled, actinomorphic to zygomorphic; capsule eglandular; fertile stamens 4; placentation axile ..... ***Erythranthe***

Diplacus Nutt.

Kimberly Hansen

Annual herbs, taprooted, stipitate glandular, puberulent to villous; stems erect, leafy throughout. LEAVES sessile to subsessile, obovate to narrowly elliptic. FLOWERS pedicellate, ebracteolate; calyx tube 5-angled, inflated in fruit, the lobes

Vascular Plants of Arizona: Phrymaceae Lopseed Family. *Canotia* 12:1–21. 2016. © K. Hansen, E. Johnson, K.O. Phillips, J. Talboom, and T. Ayers.

subequal or if unequal the upper lobe distinctly longer and broader than others; corolla nearly actinomorphic to bilabiate, magenta to violet or yellow, persisting in fruit; fertile stamens four, included. CAPSULES apically attenuate, glabrous, placentation parietal, the placentae not fused; seeds oblong, finely reticulate. —Ca. 46 species distributed in w N. Amer. WA to MT s to AZ, CA and CO with one species endemic to Mex. From the Greek *diploos* for double, in reference to capsule splitting and exposing two separate placentae.

Diplacus is easily separated from *Mimulus* (and *Erythranthe*) based on presence of sessile to subsessile flowers. It also has apically attenuate capsules and parietal placentation, features it shares with *Mimetanthe*.

1. Calyx teeth subequal, acuminate to attenuate; base of calyx and leaf axils villous; hairs greater than or equal to 1 mm long; corolla violet to magenta .....***D. bigelovii***
1' Calyx teeth unequal, the upper lobe distinctly the largest and broadest, broadly rounded to acute; base of calyx and leaf axils puberulent; hairs less than 0.5 mm long; corolla yellow or violet.....***D. parryi***

Diplacus bigelovii (A. Gray) G.L. Nesom (for Jacob Bigelow [1787–1879], physician and botanist). Bigelow's Monkeyflower. —Annual herbs, (1–)2.5–15(–24) cm tall, glandular-pubescent; stems simple to highly branched. LEAVES 11–30(–39) long, 4–14(–17) wide. FLOWERS (1–)2 per node; pedicels 1–6(–10) mm long; calyx (6–)9–10(–13) mm long, often inflated in fruit, villous at least at base with stipitate-glandular multicellular hairs; lobes subequal, acuminate to attenuate, the sinuses cuneate (rarely rounded); corolla (16–)20–28(–31) mm long, magenta to violet with two yellow patches on palate, the throat yellow with magenta to violet speckles, the lobes broadly rounded. CAPSULES exserted slightly past calyx teeth at maturity. (Figs. 1F–H; 5A). [*Mimulus bigelovii* (A. Gray) A. Gray] —2 vars. in AZ; Inyo co. CA, s NV, sw UT s to n Baja CA.

1. Distal leaf apices acute.....*D. bigelovii* var. *bigelovii*
1' Distal leaf apices aristulate to cuspidate ..... *D. bigelovii* var. *cuspidatus*

var. *bigelovii* —LEAVES 11–25(–31) mm long, 4–8(–15) mm wide, the proximal ones obovate, with an acute or rounded apex, the distal ones narrowly elliptic to lanceolate, with an acute apex. (Fig. 1H). [*Mimulus bigelovii* (A. Gray) A. Gray var. *bigelovii*] —Prefers rocky outcroppings but also found in sand and gravel soils in the Mohave and w Sonoran deserts: Mohave and La Paz cos. (Fig. 6A); 150–2200 m (500–7200 ft); Feb–Oct.

var. *cuspidatus* (A. L. Grant) G. L. Nesom —LEAVES 12–30(–39) mm long, (5–)7–17 mm wide, the proximal ones obovate to oblanceolate, with a rounded, acute, or acuminate apex, the distal ones orbicular, with an aristulate to cuspidate apex. (Fig. 1G). [*Mimulus bigelovii* (A. Gray) A. Gray var. *cuspidatus* A. L. Grant] —Often on rocky outcroppings but also found in sand, gravel and cinder soils in the Mohave Desert: Mohave co. (Fig. 6A); 400–2000 m (1300–6500 ft); Mar–Sep.

In Arizona, this variety is usually found on the south side of the Colorado River. Nesom (2013) suggested that *D. bigelovii* var. *cuspidatus* may be more closely related

to other species of *Diplacus* with similar leaf shape than to *Diplacus bigelovii* var. *bigelovii*. Further experimental work is needed.

Previous treatments have recognized *Mimulus spissus* A. L. Grant as a distinct taxon. However, Thompson (2005) suggested that it is merely a form of *Diplacus bigelovii* var. *cuspidatus* that results from high drought stress and it is therefore not recognized here.

Diplacus parryi (A. Gray) G. L. Nesom & N. S. Fraga (for Charles Parry [1823–1890], surgeon and naturalist on Mexican Boundary Surveys). Annual Redspot Monkeyflower. —Annual herbs, 1.5–6(–10.5) cm tall, stipitate glandular-puberulent; stems usually unbranched. LEAVES (6.5–)8–14(–26) mm long, (1–)1.6–4(–7.5) mm wide. FLOWERS (1–)2 per node; pedicels (0.5–)1–3(–4) mm long; calyx (6–)8–12 mm long, inflated in fruit, sparsely stipitate glandular-puberulent (rarely glabrous); lobes unequal, rounded to acute, the upper central lobe distinctly longer and broader, the remaining lobes reduced, sometimes to apicules; corolla (14–)17–22(–27) mm long, magenta or violet with two yellow patches on the palate, or yellow with 6–8 violet spots on the palate; throats yellow with purple to reddish speckling in both forms, the lobes equal, broadly rounded to truncate. CAPSULE more or less included in calyx, visible in sinuses but not exceeding the calyx teeth. (Figs. 1D–E). [*Mimulus parryi* A. Gray] —Mohave Desert in dry sandy washes and on gravel slopes: Mohave Co. (Fig. 6B); 500–1100 m (1700–3600 ft); Apr–Jun; sw UT and Inyo Co., CA.

Diplacus parryi is unusual in having two distinct color morphs, which often occur within the same population without gradation.

Erythranthe Spathe

Elizabeth Johnson, Kirstin Olmon Phillips, Joseph Talboom, and Tina Ayers

Annual or perennial herbs, taprooted to rhizomatous or stoloniferous, glabrous to glandular-pubescent; stems creeping to erect, leafy throughout or scapose. LEAVES sessile to petiolate, linear to orbicular or ovate. FLOWERS pedicellate, ebracteolate; calyx tube usually 5-angled, sometimes inflated in fruit, the lobes subequal or if unequal the upper lobe distinctly longer and broader than others; corolla nearly actinomorphic to strongly bilabiate, yellow, red, pink, purple to blue, deciduous in fruit; fertile stamens four, included or exserted. CAPSULES aristate to acuminate, glabrous in ours, placentation axile; seeds oblong to oval or fusiform. —111 species distributed in British Columbia, Can., to SD, s to n Mex. From Greek *erythros* (red) and *anthos* (flower).

Most Arizona species formerly included in *Mimulus* are now included in the genus *Erythranthe*. The primary character separating *Erythranthe* from *Mimulus* is the leaf venation; *Mimulus* in North America is weakly brochidodromous (veins arising from a prominent midvein and merging at the margin with the adjacent veins), whereas *Erythranthe* has basal acrodromous venation (multiple parallel veins separating at base of leaf and fusing at the apex). Base chromosome number also separates *Mimulus* from *Erythranthe*. *Mimulus* has a base chromosome number of $x = 8, 11, 12$ and *Erythranthe* has $x = 14, 15, 16$. Many of the species have showy, handsome flowers. *Erythranthe*

cardinalis, E. cuprea, E. guttata, E. lutea, and *E. primuloides* are cultivated. Most of the Arizona species grow in wet soil. Herbarium specimens without mature fruit and calyx are often difficult to identify.

1. Corollas red; calyx tubes 16 mm or longer (Sect. *Erythranthe*).
   2. Basal leaves fan-shaped, with apices rounded with prominent teeth; pedicels 1–3(–4.5) cm long; capsules ca. 8 mm long ..... ***E. eastwoodiae***
   2' Basal leaves oblanceolate, with apices acute without prominent teeth; pedicels 3–10 cm long; capsules 14–18 mm long.
      3. Anther sacs spreading ..... ***E. cinnabarina***
      3' Anther sacs reflexed, forming a horseshoe-shape..... ***E. verbenaceus***

1' Corollas yellow, pink, purple or blue; calyx tubes less than 16 mm long.
   4. Calyx teeth subequal; calyx not or only moderately inflated in mature fruit.
      5. Perennials, mat-forming, stoloniferous, eglandular (Sect. *Monantha*)..... ..... ***E. primuloides***
      5' Annuals, erect, taprooted, stipitate-glandular.
         6. Leaves green, ovate, widest below the middle; stems with soft, tangled hairs; corolla lobes entire to slightly notched; calyx teeth triangular and acute–acuminate (Sect. *Mimulosa*) ..... ***E. floribunda***
         6' Leaves suffused purplish-red, especially the lower surface, widest at or above the middle; stems sparsely glandular-puberulent; corolla lobes notched; calyx teeth rounded, often mucronate (Sect. *Paradantha*)
            7. Plants 1–3(–7) cm tall; internodes usually shorter than leaves; flowering pedicels 2–7(–10) mm long..... ***E. suksdorfii***
            7' Plants 3–32 cm tall; internodes usually longer than leaves; flowering pedicels 6–22 mm long ..... ***E. rubella***
   4' Calyx teeth not equal, upper calyx tooth longer than the others; calyx inflated in mature fruit (Sect. *Simiola*)
      8. Lateral calyx teeth not closing over orifice in fruit..... ***E. geyeri***
      8' Lateral calyx teeth closing over orifice in fruit.
         9. Stems mat-forming; corolla lobes fimbriate; calyx tube 2.5–4.5 mm long ..... ***E. parvula***
         9' Stems decumbent to erect; corolla lobes entire; calyx tube 3–14 mm long.
            10. Stems 1–12.5 cm long; calyx tube 3–6 mm long.
               11. Fruiting pedicels 10–40 mm long; leaves not much reduced distally; rare, Huachuca and Chiricahua Mountains .... ***E. calciphila***
               11' Fruiting pedicels 2–23(–34) mm long; leaves reduced distally, widespread ..... ***E. guttata (in part)***
            10' Stems 5–60(–90) cm long; calyx tube (3–)6–14 mm long.
               12. Stems 30–60(–90) cm long; leaves reduced distally; plants 1–many flowered; usually below 3000 m (10,000 ft); common..... ..... ***E. guttata (in part)***
               12' Stems 5–11 cm long; leaves not much reduced distally; plants 1–5(–6) flowered; usually above 3000 m (10,000 ft); rare..... ..... ***E. tilingii***

Erythranthe calciphila (Gentry) G. L. Nesom (limestone loving). —Annual herbs, fibrous rooted without rhizomes or stolons, glabrous to villosulous, stipitate glandular. STEMS usually erect, 1–12.5 cm long. LEAVES short-petiolate or the distal sub-sessile, glabrous to sparsely short villous, sometimes with stipitate glands; petioles 1–4 mm long; blades palmately 3–5 veined, orbicular to ovate, 0.5–2.2 cm long, 0.5–2 cm wide, the distal leaves barely reduced; apex subacute to rounded; base cuneate to rounded; margins shallowly serrulate, sometimes denticulate, usually with 5–7 teeth per side. FLOWERS axillary, from most axillary nodes; fruiting pedicels 1–4 cm long; calyx zygomorphic, glabrous to sparsely short-villous and stipitate glandular, pale-green to green, the tube 3–6 mm long, inflated in fruit, the dorsal teeth 0.5–2 mm long, acute, closing over orifice in fruit, the lateral teeth 0.5–0.75 mm long, acute, the upper tooth 1.5–3 mm long, acute; corolla bilabiate, yellow, sometimes sparsely red-spotted, the tube cylindric–funnelform, 5–10 mm long, exserted 1–2.5 mm beyond longest calyx tooth, the lobes entire; anthers included, the anther sacs reflexed, glabrous; stigma club-shaped. CAPSULES oblong, aristate, 4–5 mm long, included in calyx. SEEDS oval, brown. [*Mimulus calciphilus* Gentry, *Mimulus minutiflorus* Vickery] —Moist spots under rock ledges, rare, from Chiricahua and Huachuca Mountains in Cave Creek Canyon and Glance Canyon respectively: Cochise Co. (Fig 6C); 1500–2000 m (5000–6500 ft); Aug–Sep; AZ; nw Mex..

Erythranthe cinnabarina G. L. Nesom (reference to the resin of *Pterocarpus*). Cinnabar Monkeyflower. —Perennial herbs, rhizomatous, sparsely villous with sessile or stipitate glands. STEMS erect or ascending, 25–60 cm long. LEAVES sessile, glabrous to sparsely villous, the blades palmately veined, elliptic to broadly lanceolate, 6–13 cm long, 2.5–4.5 cm wide; apex acute; margins serrate. FLOWERS in pairs; fruiting pedicels 5–9.9 cm long; calyx actinomorphic, hispid, often red-tinged on veins, the tube 27–34 mm long, not inflated in fruit, the teeth subequal, 7–10 mm long, ovate, abruptly attenuate to linear-caudate; corolla bilabiate, deep orange to orange-red, the tube funnelform, 29–36 mm long, exserted 7–12 mm beyond calyx teeth, the throat yellow with hairy ridges, the lobes entire; anthers exserted, the anther sacs spreading, densely white-villous; stigmas 2-lobed. CAPSULES oblong, acuminate, 14–18 mm long, slightly exserted from calyx. SEEDS oval, brown to black. (Figs. 2E–F; 5B). — Canyons in mixed conifer forest: Cochise, Graham, and Pima, cos. (Fig. 6D); 2450–3300 m (8000–10,800 ft); Jun–Sep; AZ endemic.

Erythranthe cinnabarina is a recent segregate from *E. cardinalis* (Dougl. ex Benth.) Spach based on calyx lobes 7–10 mm long with an "abruptly attenuate to linear-caudate apex" (vs. calyx lobes 4–7 mm long with lobes that are apically attenuate–acute but not caudate in *E. cardinalis*). The corolla tubes are also longer in *E. cinnabarina* [29–36 mm vs. (15–)20–30 mm in *E. cardinalis*]. The range of *E. cinnabarina* is limited to se Arizona in the Chiricahua, Pinaleno, and Santa Catalina Mtns. while *E. cardinalis* is restricted to CA and Baja C., Mex. In Arizona this species can easily be confused with *E. verbenacea*. *Erythranthe verbenacea* has reflexed anther sacs, more cylindrical corolla tubes, and grows at or below 2600 meters (vs. divaricate or spreading anther sacs, more funnelform corolla tubes, and grows between 2450–3300 meters) (Nesom 2014).

Erythranthe eastwoodiae (Rydb.) G. L. Nesom (for Alice Eastwood [1859–1953], western botanist). Eastwood's Monkeyflower. —Perennial herbs, stoloniferous, glandular-puberulent or viscid-villous. STEMS often pendent, usually unbranched, 7–30(–45) cm long, densely villous with stipitate glands. LEAVES sessile, glandular puberulent, the blades palmately veined; proximal blades fan-shaped, 0.5–2 cm long, 1–1.5 cm wide; distal blades obovate to oblanceolate, 2.5–4.5 cm long, (0.5–)1–2 cm wide; apex acute; margins coarsely toothed. FLOWERS solitary or in pairs; pedicels 1–3(–4.5) cm long; calyx actinomorphic, hispid, often red-tinged on veins, the tube 20–30 mm long, not inflated in fruit, the teeth subequal, 3–6 mm long, lanceolate, acuminate; corolla bilabiate, dropping after anthesis, scarlet to orange-red, the tube narrowly funnelform, 30–45 mm long, exserted 15–20 mm beyond calyx teeth, the throat with hairy ridges, the lobes entire; anthers exserted, the anther sacs divaricating or reflexed, edges pilose; stigma 2-lobed. CAPSULES oblong, acuminate, ca. 8 mm long, included in calyx. SEEDS oval, brown to black. (Figs. 2A–B; 5C). [*Mimulus eastwoodiae* Rybd.] —Wet alcoves or hanging garden communities in sandstone rock walls: Apache, Coconino, Navajo cos. (Fig. 7A); 700–2500 m (2500–8000 ft); May–Oct; AZ, CO, NM, UT.

Erythranthe floribunda (Lindl.) G. L. Nesom (profusely flowering). Many-flowered Monkeyflower. —Annual herbs, taprooted, sticky, with long, tangled, stipitate glandular hairs. STEMS erect, 4–40 cm long. LEAVES petiolate, villous, the petiole 1–7 mm long, the blades pinnately to subpalmately 3-veined, lanceolate to deltoid, 0.4–3 cm long, 0.2–1.6 cm wide; apex acute; base rounded; margins usually serrate. FLOWERS axillary, 1–many in leafy racemes; pedicels 1–3 cm long; calyx actinomorphic, more or less glandular-pubescent, green to purple, often darker on veins, often spotted, the tube 0.4–0.8 cm long, not or only moderately inflated in fruit, the teeth subequal, 0.5–1 mm long, triangular and acute–acuminate, sometimes ciliate; corolla actinomorphic, yellow, red-spotted, the tube cylindrical, 6–12 mm long, exserted 1–8 mm beyond calyx teeth, the lobes entire to slightly notched; anthers included, the anther sacs reflexed, glabrous; stigma 2-lobed. CAPSULES oblong to fusiform, aristate, 3.5–5 mm long, included in calyx. SEEDS oval, yellow to tan. (Figs. 3B; 5D). [*Mimulus floribundus* Lindl., *Mimulus deltoides* Gandog., *Mimulus membranaceus* A. Nelson, *Mimulus multiflorus* Pennell, *Mimulus pedunculariis* Douglas ex Benth., *Mimulus pubescens* Benth., *Mimulus serotinus* Suksd., *Mimulus subulatus* (A. L. Grant) Pennell, *Mimulus trisulcatus* Pennell] —Crevices, seeps around granite outcrops, near streams: Apache, Cochise, Coconino, Gila, Graham, Pima, Santa Cruz, Yavapai cos. (Fig. 7B); 550–2500 m (1900–7300 ft); Mar–Jul; British Columbia, Can., MT, CA, AZ, NM, SD; Mex. (Chih.). *Erythranthe floribunda* is extremely variable in size and ours are often depauperate.

Erythranthe geyeri (Torrey) G. L. Nesom (for Karl Andreas Geyer [1809–1853], German botanist). Geyer's Monkeyflower. —Perennial herbs, often creeping and sometimes mat-forming, mostly or entirely glabrous, if hairs present, sparsely short-villous and stipitate glandular distally or on pedicels only. STEMS usually prostrate to decumbent–ascending, 3–27(–50) cm, often rooting at the nodes. LEAVES petiolate to sessile, glabrous, the proximal leaves with petioles 1–14 mm long, the distal

leaves sub-sessile to sessile, the blades palmately 3–5 veined, orbicular to ovate (reniform), 0.3–2.2(–3.2) cm long, 0.4–2.5(–4) cm wide; apex rounded to sub-acute; base cordate to rounded; margins shallowly serrulate to serrate (rarely erose) with 5–10 teeth per side. FLOWERS axillary, 2–12, usually from distal nodes but sometimes also from proximal ones, racemose; fruiting pedicels 0.3–3.5 cm long; calyx zygomorphic, the tube 4–8 mm long, glabrous to sparsely short-villous and stipitate glandular, green to purple tinged, inflated in fruit; dorsal and lateral teeth usually obsolete to 1 mm long, acute to mucronate, the upper tooth 0.5–3 mm long, acute to mucronate, teeth not closing over orifice in fruit; corolla bilabiate, yellow, sometimes sparsely red spotted, the tube funnelform, 7–15 mm long, exserted 2–4 mm beyond longest calyx tooth, the lobes entire, the palate only partially closing throat; anthers included, glabrous, reflexed; stigma club-shaped. CAPSULES oblong, aristate, 3–5 mm long, included in calyx. SEEDS oval, brown. (Figs. 4C–D; 5E–F). [*Mimulus glabratus* Kunth, *Mimulus glabratus var. jamesii* (Torr. & A. Gray ex Benth.) A. Gray, *Mimulus geyeri* Torr.] —Wet places, both in water and along stream margins, in hanging gardens, nearly vertical rock faces: Apache, Cochise, Pinal, Santa Cruz cos. (Fig. 7C); 1500–2600 m (4900–8500 ft); May–Oct; AZ; Mex.

Herbarium specimens of *E. geyeri* are easily confused with *E. guttata* when the calyx teeth are folded during pressing.

Erythranthe guttata (DC.) G. L. Nesom (spotted). Seep Monkeyflower. — Annual or perennial herbs, rhizomatous, glabrous to minutely villous; hairs eglandular to glandular. STEMS decumbent to erect, (4–)30–60(–90) cm, stout and fistulose to slender, up to 13 mm wide. LEAVES variable, petiolate often becoming sessile distally, mostly glabrous to hispidulous to minutely villous-hirsute, eglandular or glands sessile or stipitate; petioles (1–)5–60(–90) mm long, the blades palmately to sub-pinnately (3–)5–9(–11)-veined, cordate to ovate to orbicular to elliptic, (0.1–)1–8(–11) cm long, (0.15–)0.5–5(–7.5) cm wide; apex subacuminate to acute to obtuse; base cordate to truncate to cuneate; margins denticulate to dentate, serrulate to serrate, or erose, with 5–many teeth per side. FLOWERS axillary, 1–many; fruiting pedicels (0.2–)0.5–4(–7.2) cm long; calyx zygomorphic, the tube (3–)6–14 mm long, glabrous to minutely villous, green to purple, sometimes spotted, inflated in fruit, the dorsal and lateral teeth 0.5–2.5 mm long, acute to mucronate, closing over orifice in fruit, the upper tooth 1–5.5 mm long, acute to mucronate; corolla bilabiate, yellow, sometimes red-spotted, the tube funnelform, (6–)10–22 (–26) mm long, exserted 1–10 mm beyond longest calyx tooth, the palate raised and closing throat, the lobes entire; anthers included, glabrous, reflexed; stigma club-shaped. CAPSULES oblong, aristate, 3–8 mm long, included within closed calyx teeth. SEEDS oval, brown. (Figs. 5G–H). [*Mimulus guttatus* Fischer ex DC., *Mimulus langsdorfii* var. *guttatus* (Fischer ex DC.) Jepson *Mimulus nasutus* Greene, *Mimulus cordatus* Greene, *Mimulus unimaculatus* Pennel, *Erythranthe nasuta* (Greene) G. L. Nesom, *Erythranthe cordata* (Greene) G. L. Nesom, *Erythranthe unimaculata* (Pennell) G. L. Nesom] —Wet places, creeks, streams, canyon bottoms, washes, seeps, wet meadows, pools, tanks, places with intermittent water, sandy soils, limestone, bedrock: Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai cos.

(Fig. 7D); 400–3050 m (1350–10000 ft.); Dec–Oct; w U.S.; w Can.; Mex. (Baja C., Son.); introduced in CT, DE, IN, MI, NY, PA; Can. (New Bruns.); Europe.

The *Erythranthe guttata* complex is taxonomically troublesome with four to more than 20 recognized species (Grant 1924; Campbell 1950; Kearney & Peebles 1951; Pennell 1951; Barker et al. 2012; Nesom 2012, Nesom 2015). Due to the huge amount of morphological variation in this group in Arizona, and little consistency across suites of taxonomically informative characters, the morphologically variable *E. guttata* segregates recently recognized by Nesom in his treatment of the genus *Erythranthe* are not recognized here. After examining specimens from all major Arizona herbaria, the characters recently used to delineate Nesom's species are unreliable and cannot be used to put specimens into consistent groupings. The treatment presented here follows that of Thompson (1993) in the Jepson Manual regarding *M. guttatus*—"Exceedingly complex: local populations may be unique but their forms intergrade over geog[raphic region] or elevation; variants not distinguished here."

Beardsley et al. (2004) developed a phylogeny of *Mimulus s.l.* using chloroplast and nuclear DNA. Sect. *Simiola*, which is now a part of *Erythranthe*, proved to be a well-supported clade. However, within the clade the genetic distances between species were very short, suggesting the groups are very closely related and possibly very young. Characters may not yet be fixed, which may be why possible segregate taxa, closely related to *E. guttata*, have proven so difficult taxonomically.

Sect. *Simiola* in Arizona contains *E. guttata*, *E. tilingii, E. parvula*, *E. geyeri,* and *E. calciphila*, all recognized in this treatment. We do not recognize *E. cordata* (Greene) Nesom, *E. nasuta* (Greene) Nesom, or *E. unimaculata* (Pennell) Nesom, which are considered synonyms of *E. guttata* in this treatment. For a discussion of the characters used to distinguish these taxa see Nesom (2012, 2015).

Erythranthe parvula (Woot. & Standl.) G. L. Nesom (small form). —Perennial herbs, rhizomatous, mat-forming, glabrous to villous, eglandular to glandular. STEMS prostrate, 3–15 cm long. LEAVES petiolate, glabrous (scurfy) to glandular villous-hirsute, sometimes more so on adaxial surface; petioles 1–3(–7) mm long; blades palmately 3-veined, ovate to deltoid to reniform, 2–9 mm long, 2–8 mm wide; apex acute to obtuse; base cordate to truncate to cuneate; margins shallowly denticulate to dentate or serrulate to serrate, with 3–5 teeth per side. FLOWERS axillary, 1–many; fruiting pedicels 0.5–1.3 cm long; calyx zygomorphic, glabrous to villous, green to dark purple, the tube 2.5–4.5 mm long, inflated in fruit, the dorsal and lateral teeth 1–1.5 mm long, acute to mucronate, closing over orifice in fruit, the upper tooth 2–3 mm long, acute to mucronate; corolla bilabiate, yellow, sometimes red-spotted, the tube funnelform, 6–9 mm long, exserted 3–5 mm beyond longest calyx tooth, the lobes fimbriate; anthers included, glabrous, reflexed; stigma club-shaped. CAPSULES oval, aristate, 2–3 mm long, included within closed calyx teeth. SEEDS oval, brown. (Figs. 4E–H). [*Mimulus parvulus* Woot. & Standl.] —Seepy springs on cliff faces, seepage cliffs above creeks, wet soils at base of small shallow alcoves, riparian canyons and hillsides, wash banks with seeps, rocky canyon walls just above water: Coconino, Graham, Greenlee, Maricopa, Yavapai cos. (Fig. 8A); 500–1500 m (1600–5000 ft.); (Jan–)Apr–Sep; AZ, NM; Mex. (Son.).

This taxon is a recent segregate of *Erythranthe dentiloba* (B. L. Rob. & Fernald) G. L. Nesom (*Mimulus dentilobus* B. L. Rob. & Fernald), which is now believed to only occur in nw Mex.

Erythranthe primuloides (Benth.) G. L. Nesom & N. S. Fraga (primrose-like). Primrose Monkeyflower. —Perennial herbs, stoloniferous, mat-forming, glabrous to sparsely villous, eglandular. STEMS erect, 1–12 cm. LEAVES sessile or tapering into a petiolate base, glabrous to sparsely villous on adaxial side, the petioles 1–3 mm long, the blades pinnately 3-veined, oblong to obovate, 0.5–3 cm long, 0.4–1 cm wide; apex acute; base cuneate; margins entire to minutely serrate. FLOWERS solitary or in pairs on a short scape; pedicels 2–8 cm long; calyx actinomorphic, glabrous, green to purple, often darker on veins, the tube 5–9 mm long, not or only moderately inflated in fruit, the teeth subequal, 0.5–1.5 mm long, acuminate, ciliate; corolla actinomorphic, yellow, brown-spotted, the tube funnelform, 7–19 mm long, exserted 4–12 mm beyond calyx teeth, the lobes notched; anthers included, the anther sacs reflexed, woolly; stigma club-shaped. CAPSULES oblong, aristate, 5–7 mm long, included in calyx. SEEDS oval, tan to brown. (Figs. 3D; 5I). [*Mimulus primuloides* Benth., *Mimulus primuloides* var. *pilosellus* Benth., *Mimulus pilosellus* Greene, *Mimulus primuloides* var. *minimus* Benth.] —Wet meadows, seeps, streamsides, high elevation: Apache, Coconino, Greenlee cos. (Fig. 8B); 2400–2900 m (8000–9400 ft); Apr–Sep; AZ to WA.

Erythranthe linearifolia (A. L. Grant) G. L. Nesom & N. S. Fraga of CA is considered by some to be conspecific with this species and was formerly recognized as a variety of this species in *Mimulus* (*M. primuloides* var. *linearifolius* A. L. Grant).

Erythranthe rubella (A. Gray) N. S. Fraga (reddish). Little Redstem Monkeyflower. —Annual herbs, taprooted, glabrous to sparsely villous, sparsely stipitate glandular-puberulent. STEMS erect, 2–25 cm, often purplish-red; internodes usually longer than leaves. LEAVES subsessile except proximal ones, glabrous to sparsely villous on upper side, the petioles 1–10 mm long, the blades pinnately 1–3-veined, oblanceolate to rhombic, 0.3–2.7 cm long, 0.1–1.2 cm wide, purplish-red; apex acute; base cuneate; margins entire to serrate. FLOWERS axillary, 1–many, in leafy racemes; pedicels 0.5–2.2 cm long; calyx actinomorphic, stipitate-glandular, green to purple, often darker on veins, the tube 3–9 mm long, not or only moderately inflated in fruit, the teeth subequal, 0.5–1 mm long, rounded and often mucronate, often ciliate; corolla actinomorphic, yellow, purple, pink or white, red-spotted, the tube funnelform, 6–12 mm long, exserted 2–9 mm beyond calyx teeth, the corolla lobes notched; anthers slightly exerted to included, the anther sacs divaricate to slightly reflexed, glabrous; stigma 2-lobed. CAPSULES oblong, aristate, 4–5.5 mm long, included in calyx. SEEDS oval, brown. (Figs. 3A; 5J–K). [*Mimulus rubellus* A. Gray, *Mimulus gratioloides* Rydb.] —Generally in and along washes: Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma cos. (Fig. 8C); 450–2500 m (1480–7800 ft); Jan–Aug; CA, CO, NM, NV, TX, UT, WY; n Mex.

Erythranthe suksdorfii (A. Gray) N. S. Fraga (for Wilhelm Suksdorf [1850–1932], German American botanist). Suksdorf's Monkeyflower. —Annual herbs,

taprooted, sparsely stipitate glandular-puberulent. STEMS erect, 1–3(–7) cm, purplish-red; internodes usually shorter than leaves. LEAVES sessile to subsessile, stipitate-glandular, the blades pinnately 3-veined, linear to oblanceolate, 0.3–1.5 cm long, 0.1–0.5 cm wide, purplish-red; apex rounded; base truncate; margins entire. FLOWERS axillary, 1–many, in leafy racemes; pedicels 2–7(–10) mm long; calyx actinomorphic, stipitate-glandular, purple, often darker on veins, the tube 3–6 mm long, not or only moderately inflated in fruit, the teeth subequal, 1–2 mm long, rounded and often mucronate; corolla actinomorphic, yellow, red-spotted, the tube tubular–funnelform, 4–7 mm long, exserted 2–4 mm beyond calyx teeth, the corolla lobes notched; anthers slightly exserted to included, the anther sacs divaricate, glabrous; stigma 2-lobed. CAPSULES oblong, aristate, 3.5–5.5 mm long, included to slightly exserted from the calyx. SEEDS oval, tan. (Figs. 3C; 5L). [*Mimulus suskdorfii* A. Gray, *Mimulus montioides* A. Gray] —Moist, generally clay soils in full sun: Apache, Coconino cos. (Fig. 8D); 1500–2500 m (5500–8000 ft); May–Jun; CO, ID, MT, NV, OR, UT, WA, WY.

Erythranthe tilingii (Regel) G. L. Nesom (for Heinrich Sylvester Theodor Tiling [1818–1871], Latvian physician). Tiling's Monkeyflower. —Low creeping perennial herbs, stoloniferous, emerging from thick yellowish rootstocks, glabrous to stipitate-glandular on pedicels and calyces. STEMS procumbent to erect, 5–11 cm long. LEAVES petiolate, glabrous, the proximal petioles 1–10 mm long, the distal petioles generally sessile, the blades palmately 3–5-veined, elliptic to ovate, 0.5–2.5 cm long, 0.5–1.5 cm wide; apex acute to rounded; base cuneate; margins serrulate with about 5–6 teeth per side. FLOWERS axillary, 1–6; fruiting pedicels 0.9–2 cm long; calyx zygomorphic, glabrous to sparsely short-villous, green, the tube 6–9 mm long, inflated in fruit, the dorsal and lateral teeth 0.5–2 mm long, acute to mucronate, the dorsal teeth slightly longer than lateral teeth, closing over orifice in fruit, the upper tooth 2–4 mm long, acute to mucronate; corolla bilabiate, yellow, sometimes red-spotted, the tube funnelform, 14–23 mm long, exserted 4–7 mm beyond longest calyx tooth, the lobes entire, the palate raised and mostly closing throat; anthers included, glabrous, reflexed; stigma club-shaped. CAPSULES oblong, aristate, 5–8 mm long, included within closed calyx teeth. SEEDS oblong, brown. (Figs. 4A–B). [*Mimulus tilingii* Regel] —Stream channels: Coconino, Graham cos. (Fig. 9A); ca. 3050 m (10000 ft.); July; CA, CO, ID, MT, NV, WY; Can.

Erythranthe verbenacea (Greene) G. L. Nesom & N. S. Fraga (verbena-like). Scarlet Monkeyflower. —Perennial herbs, rhizomatous, sparsely villous with sessile or stipitate glands. STEMS erect or sometimes decumbent, 25–40 cm long. LEAVES sessile, glabrous to sparsely villous, the blades palmately veined, oblanceolate to narrowly lanceolate, 2–9(–13) cm long, 1–3.8(–7.5) cm wide; acute at the apex; margins irregularly serrate, sometimes with distinct reddish-brown to black zonation (Fig. 2D) across the middle of the blades. FLOWERS solitary or in pairs, the pedicels 3–11 cm long, villous; calyx actinomorphic, hispid, with darker veins, the tube 12–20 mm long, not inflated in fruit, the teeth subequal, 4–7 mm long, triangular, acuminate; corolla bilabiate, scarlet to orange-red, the tube narrowly funnelform, 25–35 mm long, exserted 10–20 mm beyond calyx teeth, the lobes entire; anthers exserted, the anther

sacs reflexed, combined horseshoe-shaped, white-villous; stigmas 2-lobed. CAPSULES oblong, acuminate, 12–16 mm long, included in calyx. SEEDS oval, brown to black. (Figs. 2C–D). [*Mimulus verbenaceus* Greene, *Mimulus cardinalis* var. *verbenaceus* Kearny & Peebles] —Moist to wet soil, usually by streams or lakes in the shade: Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Mohave, Pima, Pinal, Yavapai cos. (Fig. 9B); elevation 600–2500 m (2000–8000 ft); Mar–Oct; UT; Mex.

This species is very similar to *E. cinnabarina* but can be easily distinguished by the presence of reflexed or horseshoe-shaped anther sacs. The unique leaf zonation, common in plants from the Sycamore and Oak Creek drainages, can also be used to distinguish *E. verbenacea* from other red-flowered species. This taxon was often treated as a synonym or variety of *E. cardinalis*. Genetic studies (Beardsley et al. 2003) confirm its specific status and support *E. eastwoodiae* as its sister species, not *E. cardinalis* or *E. cinnabarina*.

Mimetanthe Greene

Kimberly Hansen

Annual herbs, 3–32(–48) cm tall, taprooted, glandular-pubescent to viscid-villous; STEMS erect, leafy throughout, unbranched to highly branched. LEAVES sessile, lanceolate to oblong, 1.5–10 mm wide; apex obtuse to acuminate; base cuneate to rounded. FLOWERS two per node, ebracteolate; pedicels 5–23 mm long; calyx (2–)4–11 mm long, not strongly inflated in fruit, bilabiate, the tube not angled, the lobes lanceolate, subequal, with apices acute; corolla nearly actinomorphic, 6.2–9 mm long, yellow, with two red to brown spots on lower lip, sparsely pilose inside tube throat, deciduous in fruit; fertile stamens 2(–4), included, didynamous, often with lower pair reduced to staminodes. CAPSULES more or less exserted from calyx at maturity, loculicidally dehiscent along distal 1/3 to 1/2 of both sutures, apically attenuate, glandular-puberulent, placentation parietal, the placentae fused at least proximally; seeds oblong to oval, reticulate. Monotypic genus distributed in w N. Amer. From Greek *mimetes* (an imitator) and *anthos* (flower) due to similarity to *Mimulus*.

Mimetanthe is easily separated from *Mimulus* (and *Erythranthe*) based on presence of parietal placentation and apically attenuate capsules, features it shares with *Diplacus*. *Mimetanthe* also has pustulate-glandular capsules, a unique feature not seen in the other Arizona species of Phrymaceae.

Mimetanthe pilosa (Benth.) Greene (hairy). Hairy Mimetanthe. (Figs. 1A–C). [*Mimulus pilosus* (Benth.) S. Watson] —Moist habitats such as stream banks, often growing in sandy soils: Gila, Graham, Maricopa, Mohave, Pima, Pinal, Yavapai cos. (Fig. 9C); 300 to 1900 m (980 to 6300 ft); Apr–Oct; WA to UT, and CA.

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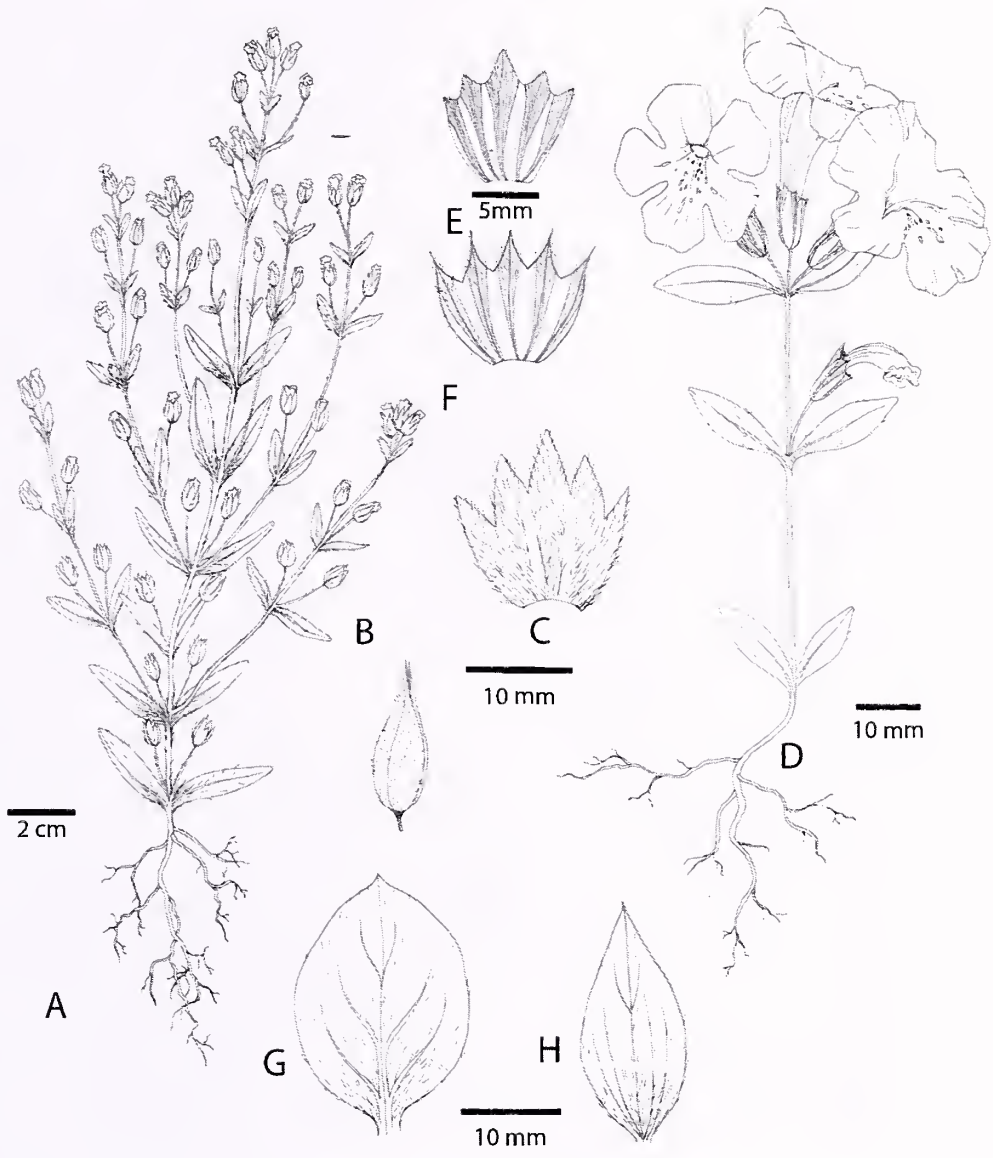
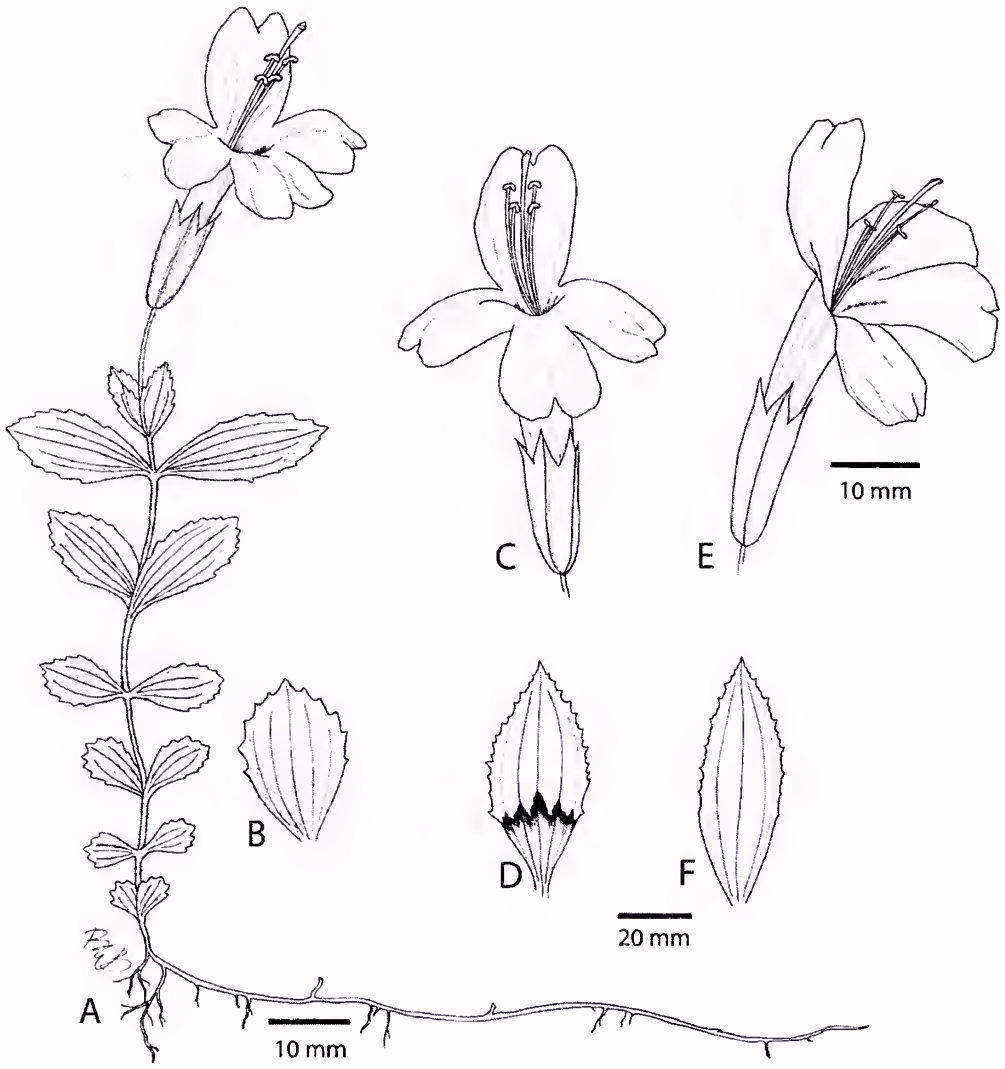
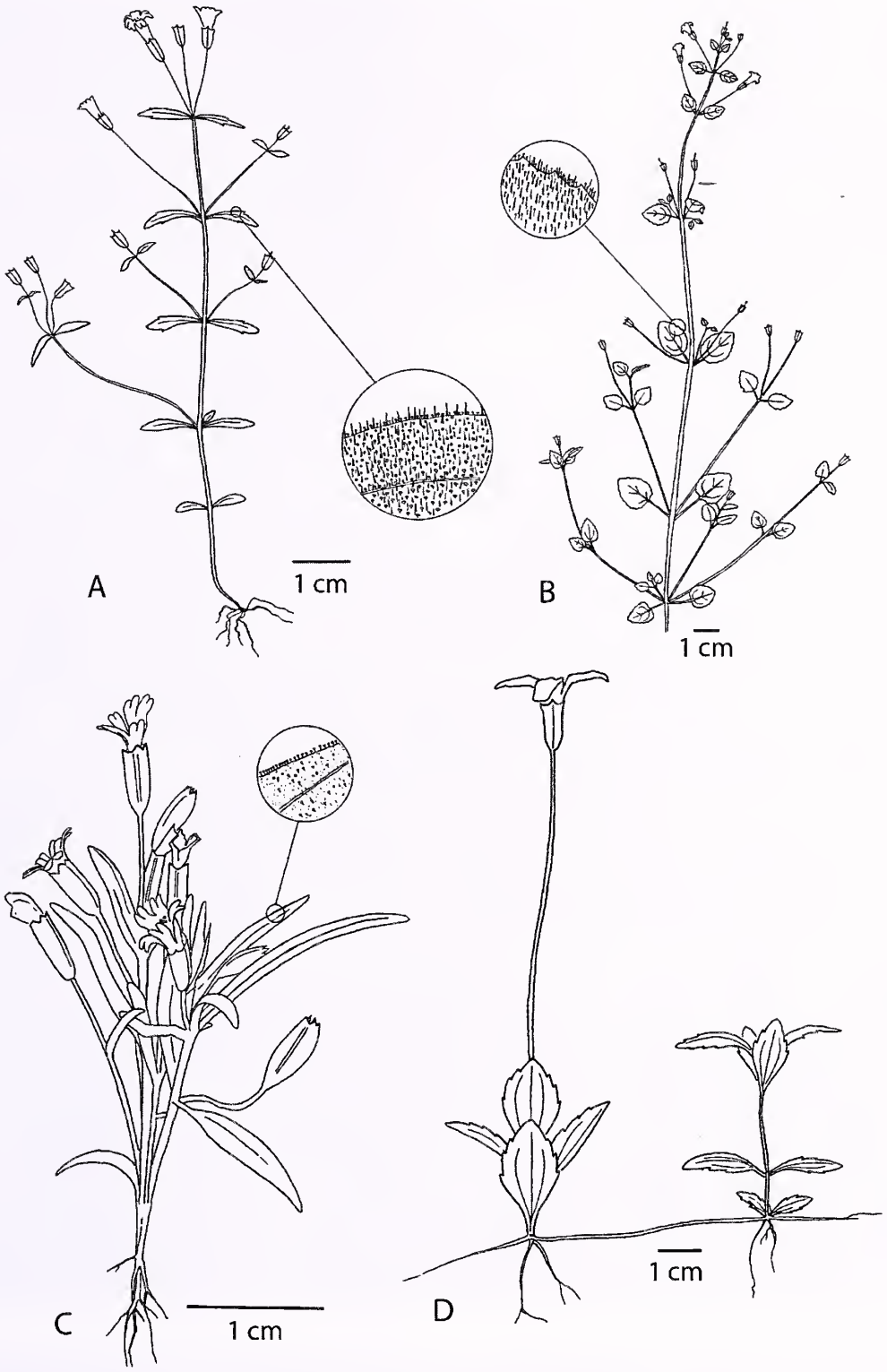


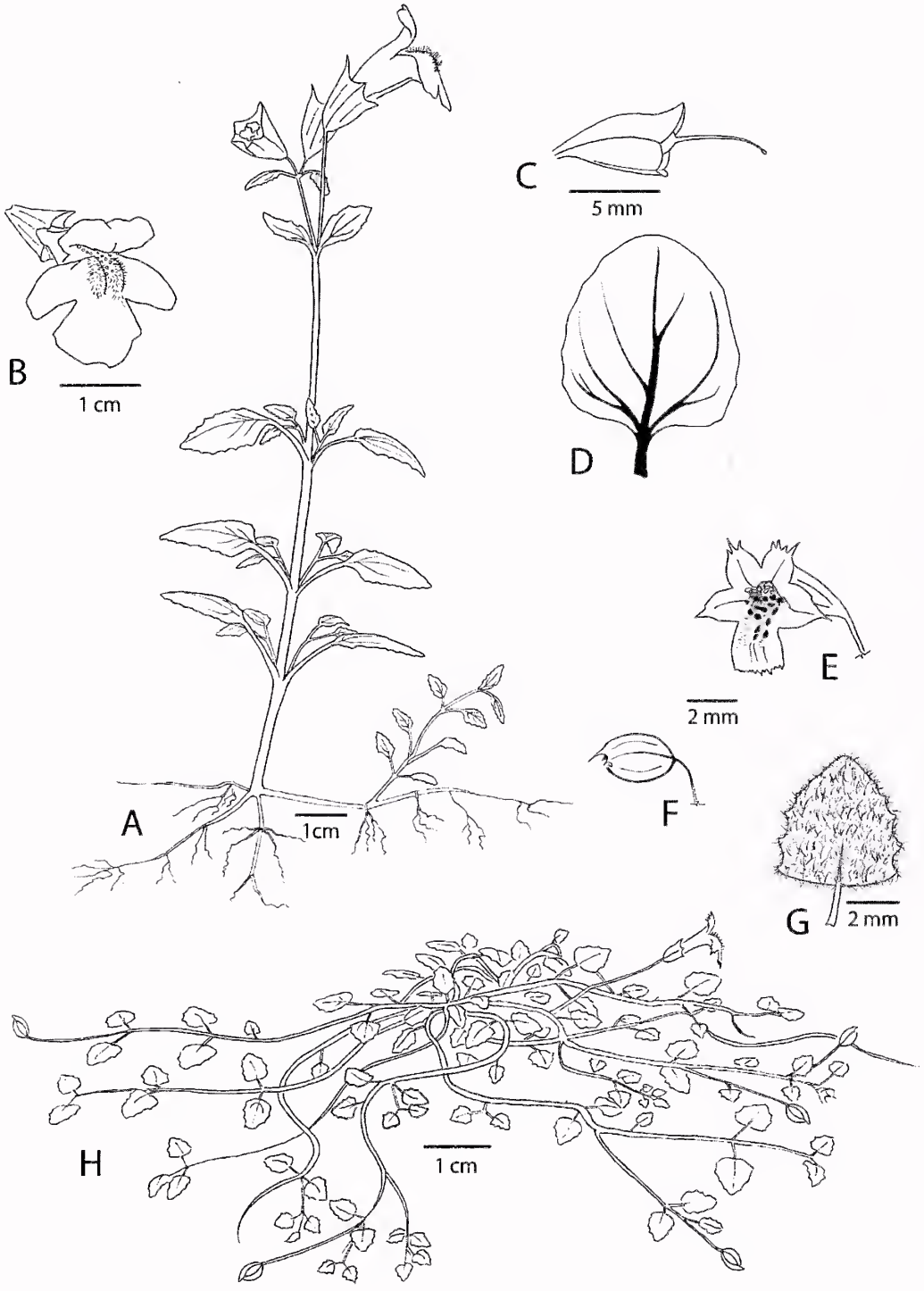
Phrymaceae. Figure 1. (A–C) *Mimetanthe pilosa*. (A) habit; (B) capsule; (C) calyx. (D–E) *Diplacus parryi*. (D) habit; (E) calyx. (F–H) *Diplacus bigelovii*. (F) calyx; (G) *D. bigelovii* subsp. *cuspidatus* leaf; (H) *D. bigelovii* subsp. *bigelovii* leaf.



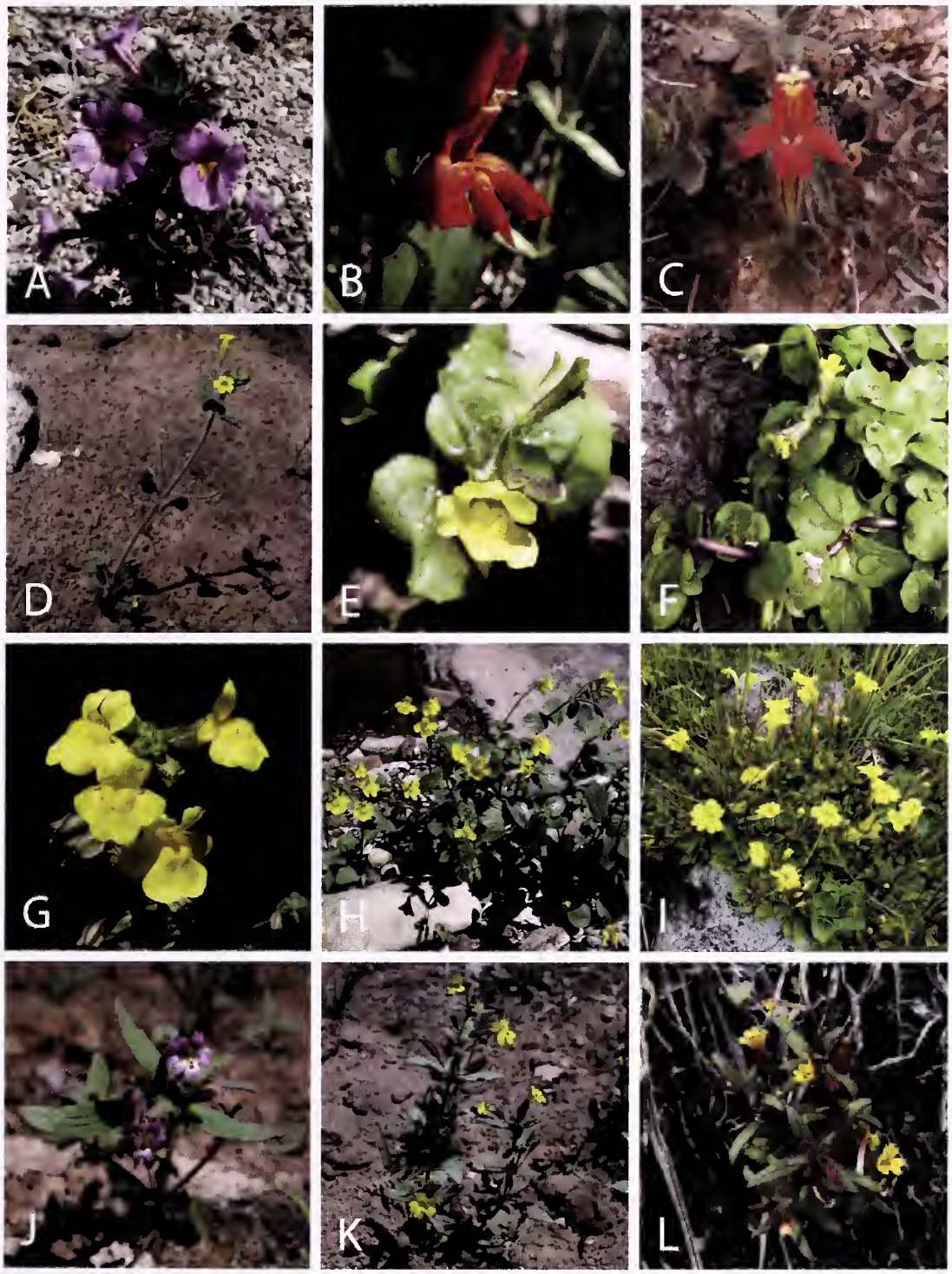
Phrymaceae. Figure 2. *Erythranthe*. (A–B) *E. eastwoodiae*, (A) habit; (B) leaf; (C–D) *E. verbenacea*; (C) flower showing distinct reflexed anther sacs; (D) leaf with zonation; (E–F) *E. cinnabarina*; (E) flower; (F) leaf.



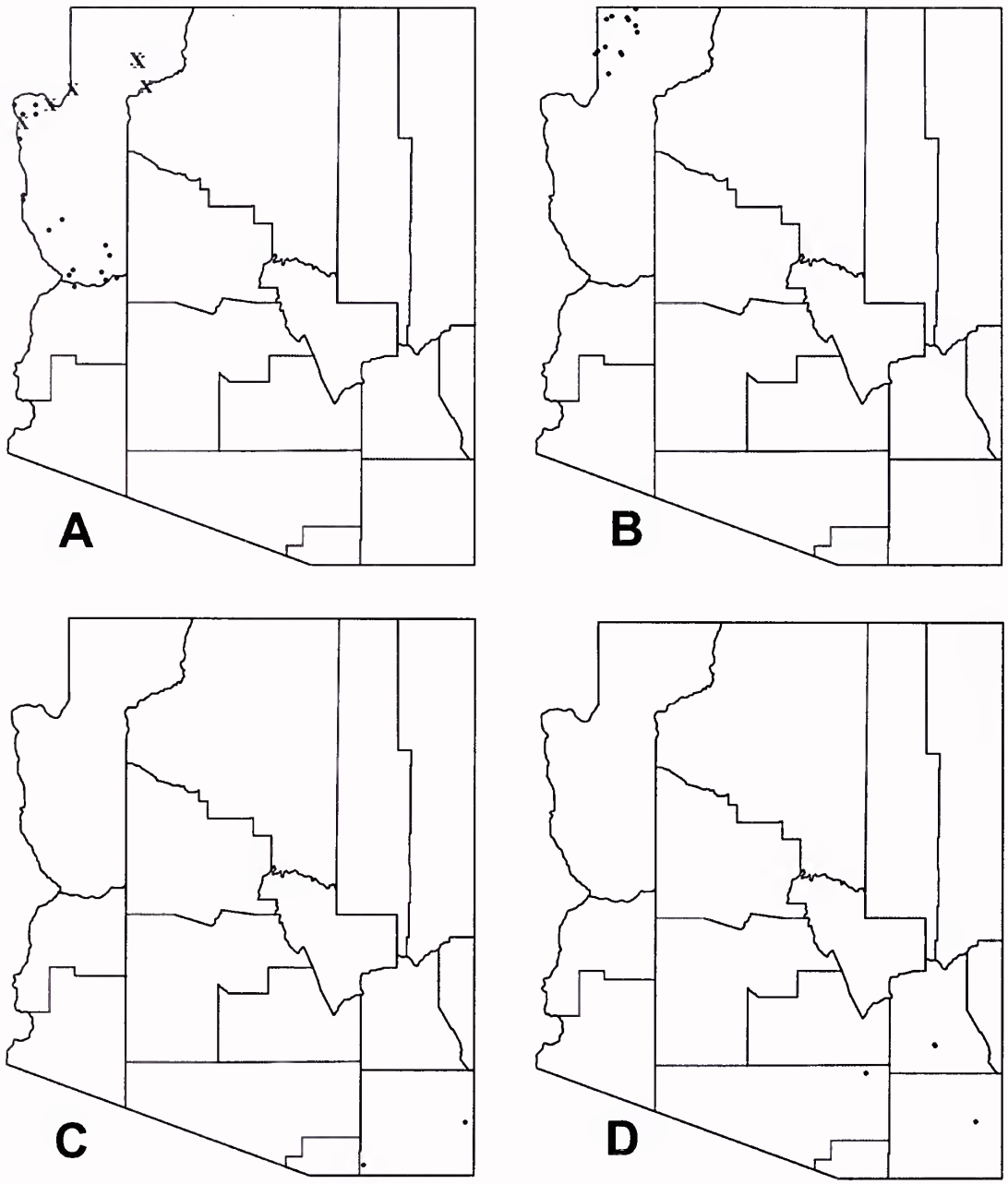
Phrymaceae. Figure 3. *Erythranthe* habit. (A) *E. rubella*; (B) *E. floribunda*; (C) *E. suksdorfii*; (D) *E. primuloides*. Insets vestiture.



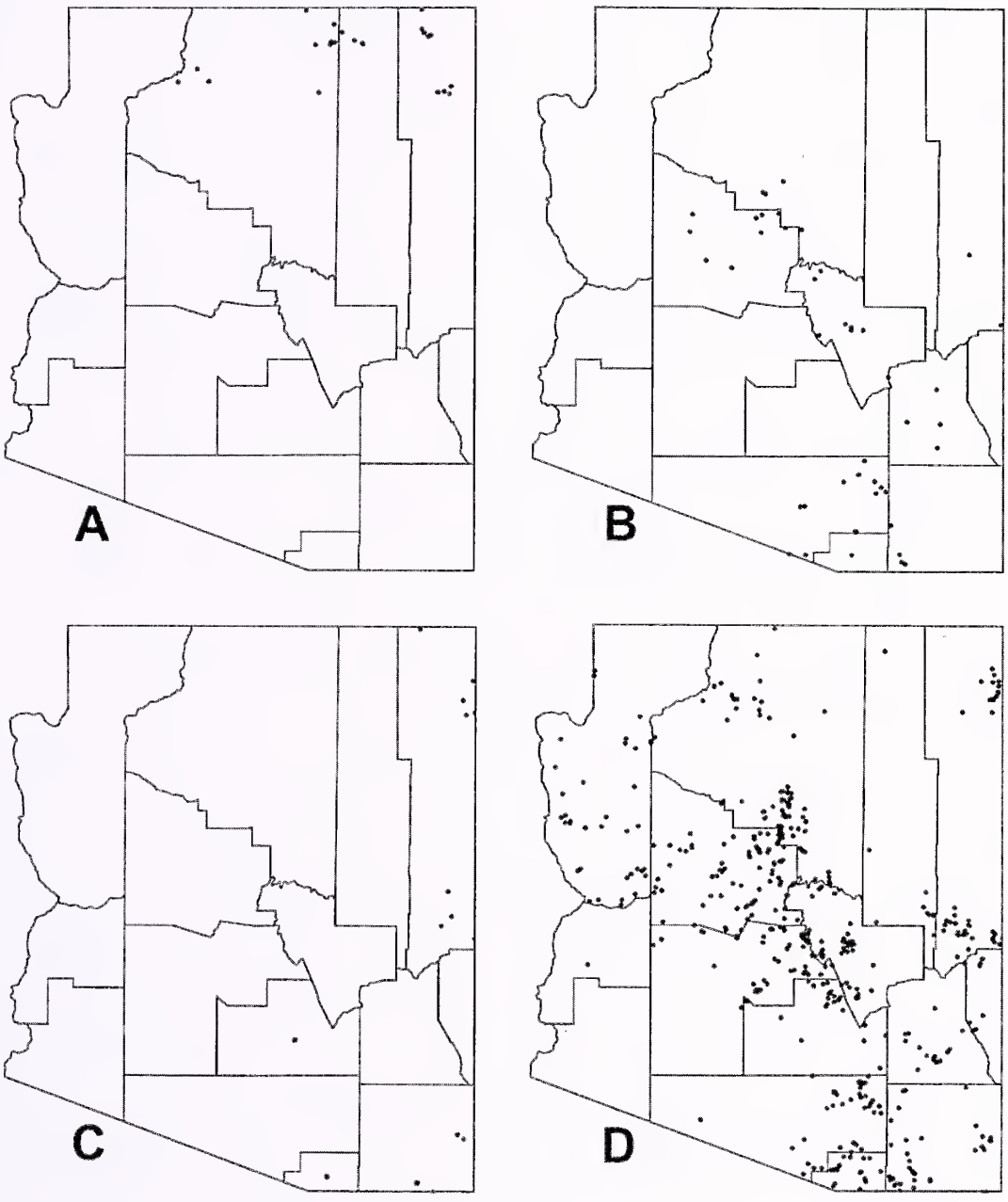
Phrymaceae. Figure 4. *Erythranthe* (A–B) *E. tilingii*; (A) habit; (B) flower; (C–D) *E. geyeri*; (C) calyx in fruit; (D) leaf; (E–H) *E. parvula*; (E) flower; (F) calyx in fruit; (G) leaf; (H) habit.



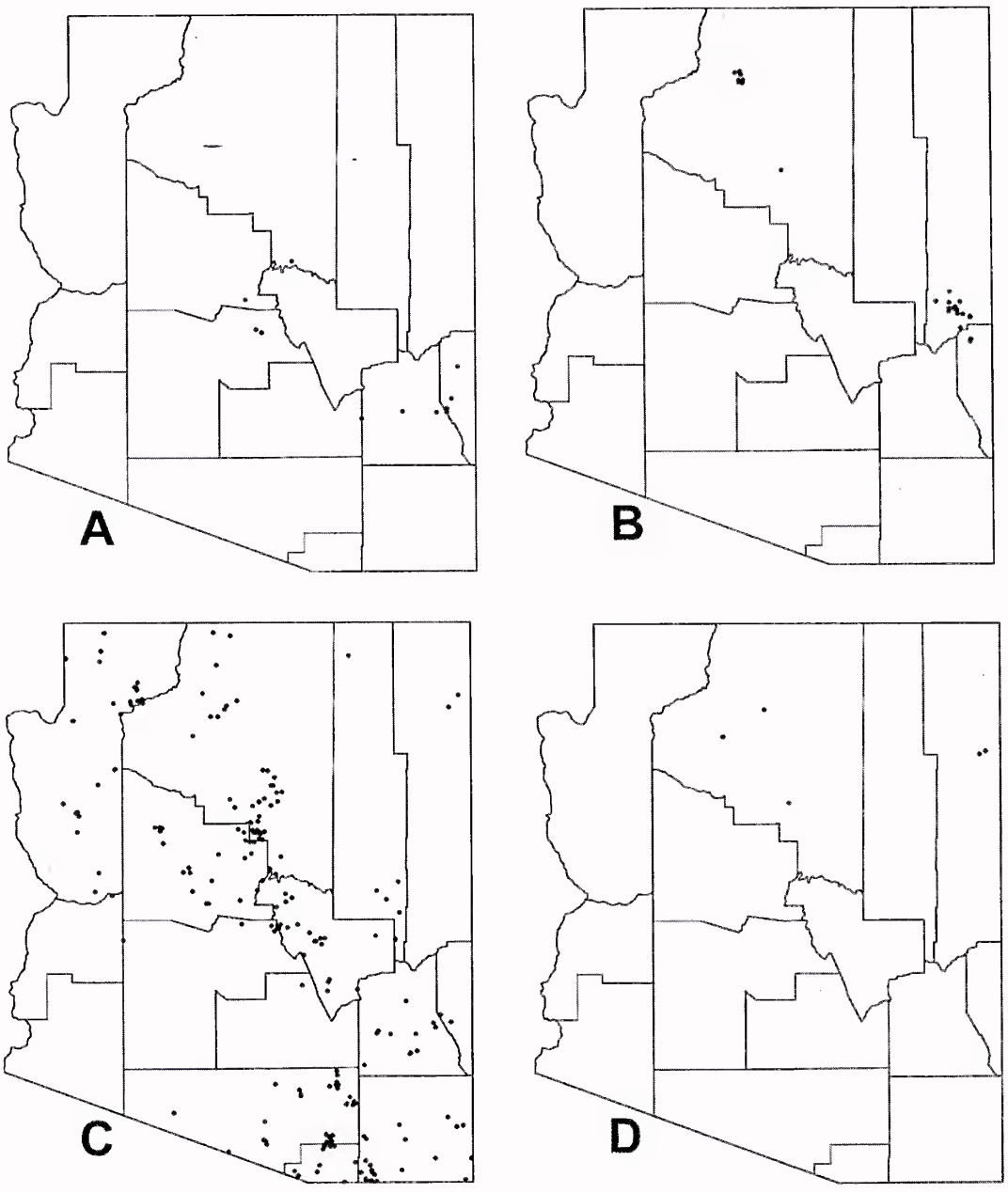
Phrymaceae. Figure 5. (A) *Diplacus bigelovii*; (B) *Erythranthe cinnabarina*; (C) *Erythranthe eastwoodiae*; (D) *Erythranthe floribunda*; (E–F) *Erythranthe geyeri*; (G–H) *Erythranthe guttata*; (I) *Erythranthe primuloides*; (J–K) *Erythranthe rubella*, (J) pink morph, (K) yellow morph; (L) *Erythranthe suksdorfii*.
(all photos ©M. Licher)



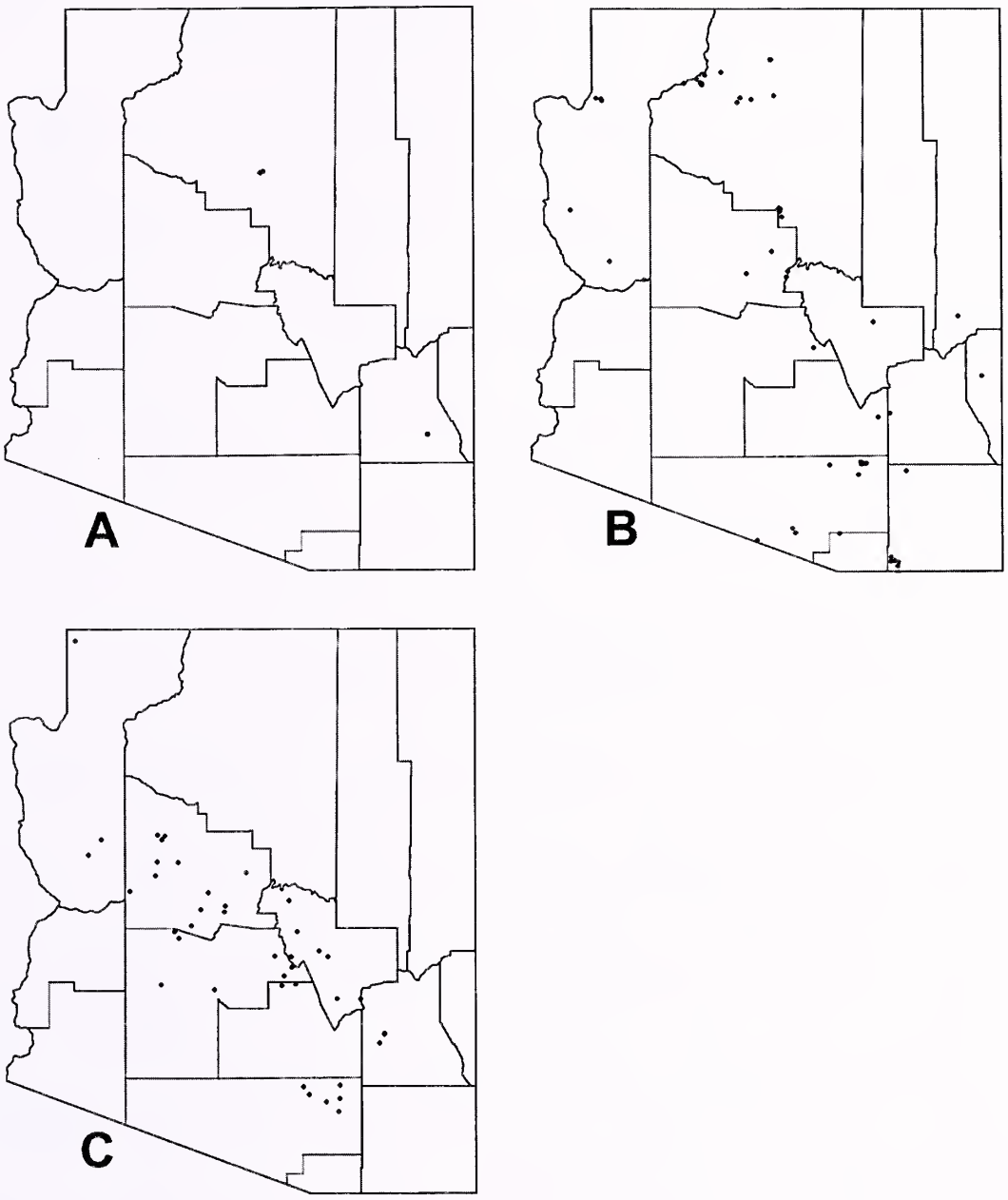
Phrymaceae. Figure 6. Distribution of: (A) *Diplacus bigelovii* var. *bigelovii* (circles) and *Diplacus bigelovii* var. *cuspidatus* (Xs) (B) *D. parryi*; (C) *Erythranthe calciphila*; (D) *E. cinnabarina.*



Phrymaceae. Figure 7. Distribution of: (A) *Erythranthe eastwoodiae*; (B) *E. floribunda*; (C) *E. geyeri*; (D) *E. guttata.*



Phrymaceae. Figure 8. Distribution of: (A) *Erythranthe parvula*; (B) *E. primuloides*; (C) *E. rubella*; (D) *E. suksdorfii.*



Phrymaceae. Figure 9. Distribution of: (A) *Erythranthe tilingii*; (B) *E. verbenacea*; (C); *Mimetanthe pilosa*.

ACANTHACEAE ACANTHUS OR SHRIMP-PLANT FAMILY

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Perennial herbs or shrubs (in ours), glabrous or pubescent, usually with cystoliths visible in epidermis (absent in *Elytraria*); trichomes simple or compound, eglandular, subglandular (i.e., lacking a conspicuous capitate gland at apex but apically enlarged), or glandular. STEMS usually articulated (i.e., constricted and/or swollen near nodes). LEAVES opposite and decussate (rarely alternate or in whorl-like clusters), simple, estipulate; margin usually entire. INFLORESCENCES of 1–many-flowered dichasia borne in axils of leaves or bracts; dichasia sessile or pedunculate, when borne in axils of bracts then usually forming dichasiate spikes (i.e., dichasia and flowers sessile to subsessile), racemes (i.e., dichasia sessile to subsessile and flowers pedicellate), or thyrses (i.e., dichasia pedunculate), if spikes or racemes or thyrses branched then forming panicles. FLOWERS sessile or pedicellate, subtended by 2 homomorphic bracteoles (in ours), bisexual; calyx 4–5-lobed, the lobes equal to unequal in length; corolla appearing subactinomorphic to strongly zygomorphic, comprising 5 variously fused petals, the tube cylindric or gradually to abruptly expanded distally into a ± distinct throat, rarely twisted 180° (i.e, *Dicliptera*), the limb 2-labiate, the upper lip of 2 partially or completely fused lobes, the lower lip 3-lobed, the corolla lobes (in ours) ascending cochlear, descending cochlear, or contorted in bud; stamens epipetalous, 2 or 4, appressed to upper lip of corolla with anthers dehiscing toward lower lip (i.e., flowers nototribic) or appressed to lower lip with anthers dehiscing toward upper lip (i.e., flowers sternotribic); anthers 2-thecous (in ours), the thecae of a pair parallel to perpendicular, equally inserted or unequally inserted (but overlapping) or superposed (not overlapping) on filament, equal to unequal in size, sometimes with basal appendages; pollen extremely diverse; staminodes 0–2; ovary superior, 2-carpellate; style simple and filiform; stigma equally or unequally 2-lobed (or with one lobe suppressed). FRUITS 2-valved capsules, explosively dehiscent, stipitate (i.e., with a sterile stipe and a fertile head) or estipitate; septa sometimes separating from inner wall of mature capsule; seeds 2–many per capsule, each subtended by a prominent hook-shaped structure here called a retinaculum (e.g., see Fig. 5F; absent in *Elytraria*), usually discoid, glabrous or pubescent. $x = 7$. —ca. 225 genera, ca. 4,000 spp., worldwide but primarily in tropics, with major centers of endemism, morphological diversity, and species richness in Indo-Malesia, Africa-Madagascar, South America, and Mexico-Central America.

The family is represented in Arizona by nine genera with 15 native and one naturalized species. Because of its extreme diversity and taxonomic utility, pollen morphology is often used to characterize genera and species of Acanthaceae (Fig. 1). The major economic importance of the family is in ornamental horticulture. Species cultivated out-of-doors in the state include six natives (*Anisacanthus thurberi*, *Dicliptera resupinata*, *Justicia californica*, *J. candicans*, *J. sonorae*, and *Ruellia ciliatiflora*), and at least 10 non-natives (*Acanthus mollis* L., *Anisacanthus andersonii*

Vascular Plants of Arizona: Acanthaceae Acanthus or Shrimp-plant Family *Canotia* 12:22-54. 2016.
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T. F. Daniel, *A. puberulus* (Torr.) Henr. & E. J. Lott, *A. quadrifidus* Standl., *Dicliptera suberecta* (André) Bremek., *Justicia adhatoda* L., *J. brandegeana* Wassh. & L. B. Sm., *J. leonardii* Wassh., *Ruellia californica* (Rose) I. M. Johnst., and *R. simplex* Wright).

1. Leaves alternate, often crowded at stem apices; inflorescences borne on peduncles covered with overlapping, coriaceous, and clasping scales; corolla lobes descending cochlear in bud; stigma touch-sensitive; fruits 3–4.3 mm long; seeds irregularly blocky, not borne on hooklike retinacula ..... *Elytraria*

1' Leaves opposite (or sometimes subopposite in *Carlowrightia linearifolia*), usually ± evenly distributed along stems; inflorescences not borne on scaly peduncles; corolla lobes not descending cochlear in bud; stigma not touch-sensitive; fruits 4–30 mm long; seeds subglobose to discoid, each borne on a hooklike retinaculum.

2. Stamens 4; corolla usually appearing subactinomorphic with 5 nearly equal lobes; lobes contorted in bud; seeds bearing appressed hygroscopic trichomes.

3. Thecae basally awned; calyx tube with subhyaline regions between lobes; corollas with colored markings within, 15–25 mm long; pollen 3-colporate and multi-striate with numerous pseudocolpi ..... *Dyschoriste*

3' Thecae lacking basal awns; calyx tube lacking subhyaline regions between lobes; corollas generally concolorous, 20–57 mm long; pollen 3-porate and coarsely reticulate ..... *Ruellia*

2' Stamens 2; corollas strongly zygomorphic with an upper lip of 2 nearly or completely fused lobes and a lower lip of 3 homomorphic or heteromorphic lobes (position of lobes reversed in *Dicliptera resupinata* which has corollas resupinate 180°); lobes ascending cochlear in bud; seeds lacking appressed hygroscopic trichomes (except in *Henrya insularis*).

4. Young stems 6-angled in cross-section; inflorescence of axillary bracteate cymes bearing (1–)3(–4) pedunculate cymules; cymules consisting of 1 or more flowers subtended by an involucre of 2 or more pairs of bracteoles; outer pair of cymule bracteoles cordate to deltate, conspicuous and larger than inner pair(s); septa with attached retinacula separating from inner capsule wall at maturity and protruding prominently from each valve of capsule, the mature capsule also conspicuously ruptured near base of head; corollas resupinate 180°; thecae superposed (contiguous or with a small gap between the pair) ..... *Dicliptera*

4' Young stems terete to quadrate (or sometimes 6-angled in *Justicia sonorae*) in cross-section; inflorescence various but not as described above; cymules never present; flowers subtended by 1 pair of bracteoles; retinacula remaining attached to inner capsule wall at maturity or separating slightly near base of head (i.e., *Henrya* and *Tetramerium*) but not protruding prominently from each valve of capsule, the mature capsule not or barely ruptured near base of head; corollas not resupinate; thecae equally to unequally inserted (but the pair always at least partially overlapping).

5. Upper lip of corolla rugulate (i.e., with a stylar furrow); stamens appressed to upper lip of corolla and anthers dehiscing toward lower lip; thecae subequally to unequally inserted, usually with a basal appendage on at least one theca (appendages absent in *J. sonorae*); pollen 2–3-

aperturate, the apertures flanked on each side by 1–3 rows of ± circular insulae (i.e., lacking pseudocolpi).....*Justicia*

5' Upper lip of corolla not rugulate (i.e., lacking a stylar furrow); stamens appressed to lower lip of corolla and anthers dehiscing toward upper lip; thecae equally to subequally inserted, lacking basal appendages; pollen 3-aperturate, apertures flanked on each side by a solid band of exine and a pseudocolpus (i.e., 6-pseudocolpate).

6. Either bracts or bracteoles conspicuous, concealing calyx; septa with attached retinacula separating slightly from inner wall of mature capsule near base of head; seeds 1.5–2.8 mm long.

7. Inflorescence dense; spikes 4-sided; bracteoles unfused, or fused only at base for a distance up to 1 mm, not forming an involucre; bracts longer than bracteoles; seeds 4, lacking trichomes; pollen with colpi narrow, not or barely exceeding width of centrally positioned ora .....*Tetramerium*

7' Inflorescence lax; spikes not 4-sided; bracteoles fused along 1 side from base to near apex, forming a conspicuous involucre; bracts shorter than bracteoles; seeds 2, pubescent with stiff, interwoven, hygroscopic trichomes to 0.7 mm long; pollen with colpi broad, far exceeding width of ora .....*Henrya*

6' Neither bracts nor bracteoles conspicuous, not concealing calyx, or if subfoliose (as in *Anisacanthus thurberi*) then at least calyx plainly visible; septa with attached retinacula remaining attached to inner wall of mature capsule; seeds 2.5–8 mm long.

8. Shrubs to 3 m tall; corollas red to orange (rarely yellowish), concolorous, 25–43 mm long; thecae 3–4 mm long; capsules 12–17 mm long .....*Anisacanthus*

8' Mostly perennial herbs to 1 m tall; corollas white or blue to purplish, with colored markings (at least on upper lip), 5.5–18 mm long; thecae 0.5–1.9 mm long; capsules 7.5–12.5 mm long .....*Carlowrightia*

Anisacanthus Nees Desert Honeysuckle

Erect shrubs with cystoliths. LEAVES opposite. INFLORESCENCES of dichasia in leaf axils or, more commonly, of dichasiate racemes (less often spikes, rarely thyrses); dichasia usually alternate, 1(–3)-flowered, sessile (less often pedunculate). FLOWERS usually pedicellate; calyces deeply 5-lobed, the lobes equal; corollas with tube gradually expanded distally, the throat indistinct to distinct, the limb 2-labiate, the upper lip comprising 2 completely or incompletely fused lobes, the lower lip 3-lobed with lobes equal and often recoiled, the corolla lobes ascending cochlear in bud; stamens 2, exserted from mouth of corolla, the thecae of a pair parallel to subsagittate, equally inserted on filament, equal in size, lacking basal appendages, dehiscing toward upper lip of corolla; pollen ellipsoid, 3-colporate, 6-pseudocolpate;

staminodes 0. FRUITS stipitate, the head subglobose, lacking a medial constriction; septa with attached retinacula remaining attached to inner wall of mature capsule; seeds to 4, discoid, lacking trichomes. —10 spp. in warm temperate and tropical regions of s N. Amer. and C. Amer. (Greek: *anisos*, unequal + *akanthos*, the genus *Acanthus*, possibly in reference to the unequal corolla lobes).

Anisacanthus thurberi (Torr.) A. Gray (for George Thurber, 1821–1890, American botanist). Thurber's Desert Honeysuckle. —Shrubs to 1.5(–3) m tall. YOUNG STEMS subquadrate, pubescent with subglandular and eglandular trichomes. LEAVES (often absent during anthesis) petiolate, the blades narrowly lanceolate to lanceolate to ovate, 11–145 mm long, 2–60 mm wide, 3.8–5.6(–13) times longer than wide. INFLORESCENCES of axillary and/or terminal dichasiate racemes; axillary racemes usually borne at nodes of older woody stems and often condensed (i.e., lacking a prominent rachis) and appearing as an axillary cluster of subfoliose bracts and flowers; dichasia sessile; bracts sometimes caducous, subfoliose, linear-lanceolate to lance-ovate to elliptic to obovate, 6.5–28 mm long, 1–8.5 mm wide; bracteoles sometimes caducous, linear-lanceolate to linear to linear-elliptic to oblanceolate, 2–20 mm long, 0.5–2.5 mm wide. FLOWERS pedicellate; pedicels 2–10 mm long, pubescent with glandular and eglandular trichomes; calyx 6.5–15.5 mm long, with subulate lobes 4.5–13 mm long, abaxially pubescent like pedicels; corollas red to orange (rarely yellowish), 25–43 mm long; stamens 19–35 mm long, the thecae red, 3–4 mm long. FRUITS 12–17 mm long, glabrous; seeds 4.8–7 mm long, 4.4–5.8 mm wide, the surfaces smooth to rugose. $2n = 36$. (Figs. 5, 14A) [*Drejera thurberi* Torr.]. —Slopes and along watercourses in Sonoran desertscrub, Chihuahuan desertscrub, desert grasslands, mesquite scrub, mesquite woodlands, and oak woodlands: Cochise, Gila, Graham, Greenlee, Maricopa, Mohave, Pima, Pinal, Santa Cruz, Yavapai, Yuma cos. (Fig. 2A); 350–2050 m (1100–6700 ft); flowering all year (peak Apr–Jun), fruiting Feb–Nov; s NM; nw Mex. (Son.).

Schroeder s.n. (ARIZ) from an unknown locale in the White Mountains of Apache County is shown on the map with a question mark because this region would appear to be beyond the native range of the species.

Carlowrightia A. Gray Wrightwort

Perennial herbs or shrubs with cystoliths. LEAVES opposite (to subopposite). INFLORESCENCES of dichasia in leaf axils or of dichasiate spikes, racemes or thyrses, these sometimes branching into panicles; dichasia alternate or opposite, 1–3 (rarely more)-flowered, sessile or pedunculate. FLOWERS sessile or pedicellate; calyces deeply 5-lobed, the lobes equal; corollas with tube cylindric to subcylindric, the throat ± indistinct, the limb pseudopapilionaceous or subactinomorphic, the upper lip comprising 2 fused lobes, the lower lip consisting of 2 similar lateral lobes and a lower-central lobe that is either similar in form to lateral lobes or conduplicate-keeled and enclosing stamens and distal portion of style during anthesis, the corolla lobes ascending cochlear in bud; stamens 2, exserted from mouth of corolla, the thecae of a pair parallel or subsagittate, subequally inserted on filament, equal in size, lacking basal appendages, dehiscing toward upper lip of corolla; pollen ellipsoid to spherical, 3-

colporate, 6-pseudocolpate; staminodes 0. FRUITS stipitate, the head flattened to globose, lacking a medial constriction, the septae with attached retinacula remaining attached to inner wall of mature capsule; seeds to 4, discoid, lacking trichomes. —26 spp. in warm temperate and tropical regions of s N. Amer.; C. Amer.; S. Amer. (for Charles Wright, 1811–1885, American botanist).

1. Shrubs to 2 m tall; corolla blue-purplish, the lower-central lobe not keel-like or enclosing stamens; filaments blue-purple, the anthers yellow; leaves sessile to subsessile, the blade linear, 4–35 times longer than wide, the midvein only evident; head of capsule globose to partially flattened ..... *C. linearifolia*

1' Perennial herbs, usually less than 1 m tall; corolla whitish (often with colored markings or veins), the lower-central lobe conduplicate (keel-like), at least partially enclosing stamens; filaments white, the anthers maroon (turning blackish); leaves generally petiolate, the blade lanceolate to ovate to cordate to elliptic, 1–3.7(–5.3) times longer than wide, with several orders of venation evident; head of capsule distinctly flattened.

   2. Corollas 8–18 mm long, the upper lip with a yellow spot outlined and streaked with maroon markings; bracteoles sessile, subulate to triangular, 0.3–1.3 mm wide; seed margin dentate; mostly Sonoran desertscrub ..... *C. arizonica*

   2' Corollas 5.5–7 mm long, the upper lip lacking a yellow spot, the veins of all lobes usually maroon; bracteoles usually petiolate, ovate to elliptic-lanceolate, 0.7–5 mm wide; seed margin entire; mostly Chihuahuan desertscrub .... *C. texana*

Carlowrightia arizonica A. Gray (of Arizona). Arizona Wrightwort, Lemilla. —Sprawling to erect perennial herbs to 1 m tall. YOUNG STEMS terete, evenly pubescent with erect to retrorse eglandular trichomes 0.05–0.5 mm long. LEAVES often absent during anthesis, petiolate or less often sessile, the blades lanceolate to narrowly ovate to cordate to elliptic, 3–36(–44) mm long, 1–11.5(–16) mm wide, 1.4–3.7(–5.3) times longer than wide, with several orders of venation usually evident (except on smallest leaves). INFLORESCENCES of dichasia in leaf axils or in axils of bracts in terminal spikes or panicles of spikes; dichasia sessile; bracts (when present) narrowly lanceolate to linear-subulate to triangular, 1–7 mm long, 0.3–1 mm wide; bracteoles sessile, subulate to triangular, 0.8–8 mm long, 0.3–1.3 mm wide. FLOWERS sessile; calyces 1.5–5 mm long, the lobes subulate, abaxially pubescent with glandular and eglandular trichomes; corollas whitish with a yellow spot outlined and streaked with maroon on upper lip, (8–)10–18 mm long, pseudopapilionaceous, the lobes of lower lip heteromorphic, the lower-central lobe conduplicate (V-shaped) and enclosing stamens, the lateral lobes not conduplicate; stamens 5–8 mm long, the filaments white, the thecae maroon, 1–1.3 mm long. FRUITS 7.5–11 mm long, the head flattened; seeds 3–4 mm long, 3–3.8 mm wide, the margin dentate with rounded tubercles or ± conic protrusions bearing retrorse barbs. $2n$ = 36. (Figs. 6, 14B). —Slopes and along watercourses in Sonoran desertscrub, Chihuahuan desertscrub, and desert grasslands: Cochise, Graham, La Paz, Maricopa, Mohave, Pima, Pinal, Santa Cruz, Yavapai, Yuma cos. (Fig. 2B); 250–1400 m (800–4600 ft); flowering Mar–May, Sep, fruiting Apr–May, Aug–Nov; s CA, w TX; Mex.; C. Amer.

Daniel (1983, 1984, 1988, 1995, 1997) discussed some of the morphological variation and its geographic basis in this widely distributed species. Two forms are recognizable in Arizona. One (represented by the type, *Daniel 203*, and *Kearney & Peebles 14567*; Fig. 6A) has retrorse to retrorsely appressed cauline trichomes 0.05–0.2 mm long, inflorescences of slender secund spicate axes with bracts 1–3 mm long, calyces 1.5–3.5 m long, corollas 9–13 mm long, and capsules 7.5–10 mm long. The other (represented by *Daniel 173* and *Jenkins & McLaughlin 708*; Fig. 6B) has erect to retrorse cauline trichomes 0.1–0.5 mm long, inflorescences of stout spicate axes with dichasia opposite at nodes and bracts 3.5–7 mm long, calyces 2.5–5 mm long, corollas 10–18 mm long, and capsules 9–11 mm long. The two forms have often been collected growing near one another but apparently do not hybridize (see Daniel 1983, 1984).

Carlowrightia linearifolia (Torr.) A. Gray (linear leaves). Heath Wrightwort. —Erect shrubs to 2 m tall. YOUNG STEMS terete, evenly pubescent with erect eglandular trichomes to 0.1 mm long. LEAVES opposite to subopposite, sessile (to subsessile), the blades linear, 10–55 mm long, 0.5–2(–3) mm wide, (5–)10–25(–35) times longer than wide, the midvein only evident on both surfaces. INFLORESCENCES usually of 1 or more racemes or thyrses to 25 cm long, collectively forming a terminal leafy panicle; dichasia sessile or pedunculate; bracts linear, (1.5–)3–20(–35) mm long, 0.4–1 mm wide; bracteoles sessile, linear, 1–10 mm long, 0.3–0.6 mm wide. FLOWERS sessile or short-pedicellate; calyces 1.5–5.2 mm long, externally puberulent, the lobes linear to triangular; corollas blue to purplish with a white to yellow spot outlined and streaked with dark purple veins on upper lip, (7.5–)9–12 mm long, subactinomorphic, the lobes of lower lip homomorphic, not conduplicate; stamens 5.5–6 mm long, the filaments purple, the thecae golden yellow, 1.1–1.9 mm long. FRUITS 10.5–12.2 mm long, the head globose to partially flattened; seeds 3.8–4.5 mm long, 3.5–4.5 mm wide, the margin entire. $2n = 36$. (Fig. 14C). [*Schaueria linearifolia* Torr.]. —Rocky or sandy washes mostly in Chihuahuan desertscrub: Cochise, Graham, Greenlee, Pima cos. (Fig. 2C); 950–1500 m (3200–5000 ft); flowering and fruiting Aug–Oct.; s NM, w TX; n Mex. (Chih., Coah.).

A collection of *C. linearifolia*, *Shreve 4388* (putatively from northern Apache Co.), is well beyond the range of this species and is not included on the map.

Carlowrightia texana Henr. & T. F. Daniel (of Texas). Texas Wrightwort. —Erect to decumbent perennial herbs to 3.5 dm tall. YOUNG STEMS quadrate to terete, evenly and ± densely pubescent with retrorse eglandular trichomes 0.1–0.5(–1) mm long. LEAVES petiolate, the blades (deltate to) broadly ovate to circular when larger, narrowly ovate to elliptic when smaller, (2.5–)6–16(–42) mm long, (1.5–)3–11(–33) mm wide, 1–3.5 times longer than wide, several orders of venation evident. INFLORESCENCES usually of dichasia in leaf axils (rarely of dichasia borne in axils of bracts in terminal spikes to racemes); dichasia sessile or short-pedunculate; bracts (if present) 2–5 mm long, 1–3 mm wide; bracteoles usually petiolate, narrowly ovate to elliptic-lanceolate, 2–12 mm long, (0.7–)2.5–5 mm wide. FLOWERS sessile to subsessile; calyx (2.5–)3–6 mm long, externally pubescent like leaves, the lobes subulate; corolla white with maroon veins on lobes, 5.5–7 mm long, pseudopapilionaceous, the lobes of lower lip heteromorphic, lower-central lobe

conduplicate (U-shaped) and at least partially enclosing stamens, the lateral lobes not conduplicate; stamens 3.3–5 mm long, the filaments white, the thecae maroon, 0.5–1 mm long. FRUITS 7.5–12.5 mm long, the head flattened; seeds 4.2–6 mm long, 3.5–4.9 mm wide, the margin entire. $2n = 36$. (Fig. 14D). —Floodplain on granite substrate in Chihuahuan desertscrub: Cochise Co. (Fig. 3D); 1150 m (3800 ft); flowering Sep; fruiting unknown in Arizona; se NM, TX; n Mex.

This species is known only from a single collection in Arizona. The description above has been augmented with data from extralimital plants.

Dicliptera Juss.

Annual or perennial herbs with cystoliths. YOUNG STEMS ± distinctly 6-angled in cross-section. LEAVES opposite. INFLORESCENCES of pedunculate (or rarely subsessile) cymes (= modified dichasia ?) bearing 1 or more bracteolate cymules in axils of leaves ± throughout plant; cymes subtended by paired bracts; cymules 1–several-flowered, pedunculate, comprising an involucre of several pairs of bracteoles, the outermost pair conspicuous and larger than inner (often hyaline) pair(s). FLOWERS sessile; calyces deeply 5-lobed, reduced and hyaline, the lobes equal to subequal; corollas resupinate (i.e., tube twisted 180°), with tube cylindric to gradually expanded distally but lacking a distinct throat, 2-labiate, the lip in upper position shallowly 3-lobed, the lip in lower position entire to 2-fid, the corolla lobes ascending cochlear in bud; stamens 2, exserted from mouth of corolla, the thecae of a pair parallel, superposed on filament (contiguous or with a small gap between the pair), subequal in size, lacking basal appendages, dehiscing toward lip in upper position; pollen ellipsoid, 3-colporate, 6-pseudocolpate; staminodes 0. FRUITS estipitate to substitpiate, ellipsoid to obovoid, lacking a medial constriction, the septa with attached retinacula separating elastically and rising from inner wall of mature capsule; seeds to 4, ± discoid, lacking trichomes. —Ca. 150 spp. in temperate and tropical regions worldwide. (Greek: *diclis*, double-folding + *pteron*, wing, possibly in reference to the several pairs of bracteoles).

Dicliptera resupinata (Vahl) Juss. (resupinate). Arizona Foldwing. — Sprawling to erect herbs to 8 dm tall. YOUNG STEMS with internodes glabrous to sparsely pubescent with retrorse eglandular trichomes to 0.3 mm long, the nodes pubescent with flexuose eglandular trichomes to 0.6 mm long. LEAVES petiolate, the blades lanceolate to ovate, 20–55(–80) mm long, 4–25(–42) mm wide, 1.4–5 × longer than wide. INFLORESCENCES with cymes alternate or opposite at nodes, 1–2 per axil, the peduncles (1.5–)2.5–35 mm long; bracts subtending cymes subulate to oblanceolate to narrowly elliptic, 2–6(–10) mm long, 0.2–1.5 mm wide (rarely subfoliose and up to 30 mm long and 5 mm wide); cymules (1–)3(–4) per cyme, peduncles (1.5–)6–50 mm long, the outer cymule bracteoles cordate to deltate to reniform (the pair sometimes fused at base), 5–15 mm long, (4–)5–14 m wide, those of a pair equal to unequal in size (one 1–1.4 × longer than the other). FLOWERS sessile; calyces 2–3 mm long; corollas pink with white markings on lip in upper position, (8–)13–20.5 mm long; stamens (3.5–)8–11.5 mm long, the thecae pink, 1–1.2 mm long. FRUITS 4–6 mm long, glabrous; seeds 1.5–2 mm long, 1.9–2.2 mm wide, the surfaces spinose-tuberculate, the tubercles bearing retrorse barbs or branches. $2n = 80$. (Figs. 7,

14E). [*Justicia resupinata* Vahl, *Dicliptera pseudoverticillaris* A. Gray, *D. torreyi* A. Gray, *Diapedium torreyi* (A. Gray) A. Heller]. —Slopes and along watercourses in Sonoran desertscrub, desert grasslands, chaparral, and riparian forests: Cochise, Pima, Pinal, Santa Cruz cos. (Fig. 2D); 750–1800 m (2400–4700 ft); flowering Mar–Dec, fruiting Apr–May, Aug–Dec.; w Mex.

Flowering in Arizona is bimodal with peaks in April–May and September–October. Daniel (1997) discussed some of the morphological variation of this species in northwestern Mexico. Arizona plants are rather homogeneous with most of their conspicuous variation related to the peduncle length of the cymes and cymules.

Dyschoriste Nees Snakeherb

Decumbent to erect perennial herbs with cystoliths. LEAVES opposite. INFLORESCENCES of dichasia in leaf axils ± throughout plant; dichasia opposite, 1–3(–many)-flowered, subsessile to short-pedunculate. FLOWERS sessile to subsessile; calyces 5-lobed, the tube often ± as long as lobes during anthesis, the regions of tube between lobes (i.e., below sinuses) subhyaline, often splitting nearly to base in fruit, the lobes usually ± setaceous; corollas with tube gradually or abruptly expanded distally into a ± distinct throat, subactinomorphic to 2-labiate, the upper lip 2-lobed, the lower lip 3-lobed, the corolla lobes contorted in bud; stamens 4, at least partially exserted from mouth of corolla; , the thecae of a pair parallel to subsagittate, equally inserted, equal in size, appendaged at base with awns, dehiscing toward lower lip; pollen 3-colporate, irregularly polypseudocolpate; staminodes 0. FRUITS substipitate, ellipsoid to obovoid, the septae with attached retinacula remaining attached to inner wall of mature capsule; seeds to 4, discoid, covered with appressed hygroscopic trichomes. —ca. 75 spp. in warm temperate and tropical regions worldwide. (Greek: *dys*, with difficulty + *choristos*, separated, possibly in reference to the capsule valves).

Dyschoriste decumbens (A. Gray) Kuntze (decumbent). Trailing Snakeherb. —Erect or usually decumbent-trailing herbs to 3.5 dm long and to 1.5 dm tall. YOUNG STEMS subquadrate to quadrate-sulcate, evenly pubescent with erect to flexuose to retrorse to antrorse to antrorsely-appressed eglandular trichomes 0.05–0.2 mm long, the trichomes sparse to dense. LEAVES subsessile to short-petiolate, the blades obovate to oblanceolate to elliptic, 7–37 mm long, 2.5–13 mm wide, 2.2–4.1 times longer than wide. INFLORESCENCES with dichasia borne on peduncles to 3 mm long; bracteoles foliose, oblanceolate to elliptic, 10–30 mm long, 2–6 mm wide. FLOWERS with calyces 10–16(–20 in fruit) mm long, the lobes subulate; corollas blue-purple to pink-purple with white area on lower lip, 15–25 mm long; stamens with longer pair 5–7 mm long, the thecae 1.1–1.7 mm long, the basal awn 0.05–0.1 mm long. FRUITS 10–13 mm long, glabrous; seeds 3–3.5 mm long, 2–2.2 mm wide. $2n = 30$. (Figs. 8, 14F). [*D. schiedeana* (Nees) Kuntze var. *decumbens* (A. Gray) Henr.]. —Flats, slopes, and along watercourses in grasslands, oak woodlands, and Madrean evergreen woodlands: Cochise, Pima, Santa Cruz cos. (Fig. 3A); 1200–2100 m (4000–7000 ft); flowering Mar–Oct, fruiting Jun–Oct; s NM, w TX; Mex.

Two forms of the species are present in Arizona. One (e.g., *Lehto 24512*, *Reeves R2751*, *Wilken & Deacon 14348*, *Elias & Petteys 8392*) has stems often erect and all

vegetative parts densely covered with erect to curved to ± appressed trichomes 0.05–0.2 mm long (with plants appearing gray-green canescent). The other (e.g., *Parfitt et al. 4018*, *Pinkava et al. 795*, *Elias et al. 9009*) has stems ± prostrate, leaves that tend to be larger, and vegetative parts sparsely pubescent with similar trichomes (plants green). Many collections (e.g., *Daniel & Butterwick 2936*) are intermediate between these extremes.

Elytraria Michx. Scaly Stem

Erect to ascending, acaulescent to caulescent perennial herbs lacking cystoliths. LEAVES alternate, in basal rosettes or crowded at apices of branches or ± diffuse along stems. INFLORESCENCES of pedunculate densely bracteate axillary and terminal dichasiate spikes; peduncles covered with overlapping, coriaceous, and clasping scales; spikes cylindric, simple or sometimes branched; dichasia alternate (spirally arranged), 1-flowered, sessile; bracts clasping; bracteoles ± hyaline. FLOWERS sessile; calyces deeply 4-lobed, mostly hyaline, the lobes heteromorphic, the anterior and posterior lobes external, the anterior lobe 2-fid; corollas with tube cylindric or slightly expanded near mouth, the throat indistinct or evident only near mouth, the limb 2-labiate, the upper lip 2-lobed, the lower lip 3-lobed, the corolla lobes often apically divided or 2-cleft, descending cochlear in bud; stamens 2, anthers partially exserted from mouth of corolla, the thecae of a pair covered by stigma during anthesis, parallel, equally inserted on filament, equal in size, lacking basal appendages, dehiscing toward lower lip; pollen ellipsoid, 3-colpate; staminodes 0–2, minute. FRUITS estipitate, subconic to ovoid, sometimes irregularly constricted proximally, retinacula absent; seeds to 20, irregularly shaped (often blocky or cubelike), lacking trichomes. —21 spp. in warm temperate and tropical regions worldwide. (Greek: *elytron*, sheath, referring to the scales and bracts)

Elytraria imbricata (Vahl) Pers. (imbricate). Purple Scaly Stem. — Subcaulescent to caulescent perennial herbs to 2 dm tall. YOUNG STEMS glabrous or very sparsely pubescent. LEAVES (often absent during anthesis) alternate, often in whorl-like clusters, subsessile to short-petiolate, the blades lanceolate to oblanceolate, 17–80 mm long, 4–23 mm wide, 1.7–6.7 × longer than wide. INFLORESCENCES with peduncles 15–95 mm long; scales lance-subulate to lanceolate, 2.5–5 mm long, acuminate-mucronate at apex; spikes 3–7 mm in diameter near midpoint, sometimes clustered; bracts lance-ovate, 4–6 mm long, 1.5–2 mm wide, 3-toothed at apex, the central tooth awnlike, the lateral teeth hyaline and winglike; bracteoles lance-subulate to lanceolate, 2–5 mm long. FLOWERS with calyces 2.5–5 mm long, the anterior lobe linear to linear-lanceolate, 2–4.5 mm long, the posterior lobe elliptic, 4–4.5 mm long, 1–1.5 mm wide, the lateral lobes linear to lanceolate, 2–4.2 mm long; corollas blue (to pink or purple) with white and orange markings on lower lip (rarely entirely white), 4–11 mm long; stamens 1.2–1.5 mm long, the thecae 0.5–0.9 mm long; stigma 0.4–0.7 mm wide, touch-sensitive. Fruits 3–4.3 mm long, glabrous; seeds 0.3–0.8 mm long, the surfaces minutely papillose. $2n = 22, 24$. (Figs. 9, 14H). [*Justicia imbricata* Vahl]. — Rocky slopes and along watercourses in desertscrub, grasslands, oak woodlands, and mesquite-dominated areas: Cochise, Pima, Santa Cruz cos. (Fig. 3B); 1050–1500 m

(3400–5000 ft); flowering Mar–Nov (peak in Sep), fruiting Apr–Oct.; s NM, w TX; Mex.; C. Amer.; S. Amer.

This is the most widespread species in the genus and occurs as a weed in portions of its range. White-flowered individuals or populations are rarely encountered in some portions of the range of this normally blue-flowered species, including Arizona (e.g., *Charlton 2540*).

Henrya Nees ex Benth. Henrya

Erect or ascending perennial herbs or shrubs with cystoliths. LEAVES opposite. INFLORESCENCES of axillary and terminal dichasiate spikes collectively forming leafy terminal panicles; dichasia alternate or opposite, 1–3-flowered, sessile or short-pedunculate; bracteoles oblanceolate to obovate, larger and more conspicuous than bracts, concavoconvex, fused from base to near apex along the side adjacent to rachis, apically mucronate. FLOWERS sessile; calyces minute, deeply 5-lobed; corollas with tube subcylindric to cylindric, the throat indistinct, the limb pseudopapilionaceous, the upper lip comprising 2 fused lobes, the lower lip 3-lobed, the lateral lobes similar to one another, the lower-central lobe conduplicate (keel-like), the corolla lobes ascending cochlear in bud; stamens 2, exserted from mouth of corolla, the thecae of a pair parallel, equally to subequally inserted on filament, subequal in size, lacking basal appendages, dehiscing toward upper lip; pollen ellipsoid, 3-colporate, the colpi broad (i.e., far exceeding width of centrally positioned ora), 6-pseudocolpate; staminode 0. FRUITS stipitate, the head subglobose to broadly ellipsoidal, lacking a medial constriction, the septae with attached retinacula separating slightly from inner wall of mature capsule; seeds to 2, plano-convex, the flat surface smooth to bumpy, the convex surface and margin pubescent with hygroscopic trichomes. —2 spp. in warm temperate and tropical regions of sw N. Amer.; C. Amer. (for Aimé Henry, 1801–1875, French artist, publisher, and botanical author).

Henrya insularis Nees ex Benth. (of islands). Common Henrya. —Perennial herbs to 3 dm tall. YOUNG STEMS quadrate, ± densely pubescent with eglandular and glandular trichomes 0.1–0.8 mm long (glandular-pubescent). LEAVES subsessile to petiolate, the blades ovate to elliptic, 10–65 mm long, 8–44 mm wide, 1.8–2.4 × longer than wide. INFLORESCENCES of lax spikes to 20 cm long, the rachis glandular-pubescent; bracts (linear to) oblanceolate, 3–4.5 mm long, 0.8–2 mm wide, bracteoles oblanceolate, 7–10 mm long. FLOWERS with calyces 1–2 mm long, the posterior lobe sometimes reduced in size; corollas yellowish with maroon or reddish markings on upper lip, 9–13 mm long; stamens 6–8.5 mm long, the thecae 1.5–2 mm long. Fruits 5–7 mm long, glabrous or sparsely pubescent at apex; seeds 1.6–2.8 mm long, the hygroscopic trichomes of convex surface and margin 0.3–0.7 mm long. $2n = 36$. (Figs. 10, 14G). [*Henrya brevifolia* Happ]. —Along watercourses in region of Madrean evergreen woodland: Santa Cruz Co. (Fig. 3C); 1150 m (3800 ft); flowering Jun, fruiting Jun.; Mex.; C. Amer.

Daniel (1990) discussed regional morphological variation of *H. insularis* throughout its range. Plants are known in Arizona only from the lower reaches of Sycamore Canyon in the Parajito Mts. along the Arizona-Sonora border west of

Nogales. The above description has been augmented using collections from nearby regions in Sonora. Sterile collections of this species can be distinguished from those of *Tetramerium* and *Carlowrightia* by the absence of petiolar stubs in *Henrya*. In the former genera, the petioles usually detach a short distance from their base leaving petiolar stubs at the nodes.

Justicia L. Justĭcia

Decumbent to erect perennial herbs or shrubs with cystoliths. LEAVES opposite. INFLORESCENCES of dichasia in leaf axils or of axillary and/or terminal dichasiate spikes or thyrses, both spikes and thyrses sometimes branched and forming panicles; dichasia alternate or opposite, 1–3(–many)-flowered, sessile or pedunculate. FLOWERS sessile or pedicellate; calyces deeply 4–5-lobed, the lobes equal or unequal in size; corollas with tube cylindric to expanded distally, sometimes lacking a distinct throat, the limb strongly zygomorphic, 2-labiate, the upper lip internally rugulate (i.e., with a stylar furrow), comprising 2 fused lobes, the lower lip 3-lobed, the corolla lobes ascending cochlear in bud; stamens 2, exserted from mouth of corolla, the thecae of a pair parallel to perpendicular, equally or unequally inserted on filament, equal or unequal in size, 1 or both with a basal appendage or appendages absent, dehiscing toward lower lip; pollen ellipsoid, 2–3-aperturate, the apertures flanked on each side by 1–several rows of ± circular insulae and/or peninsulae; staminodes 0. FRUITS stipitate, the head subglobose to ellipsoid to ovoid, usually with a medial constriction, the septa with attached retinacula remaining attached to inner wall of mature capsule; seeds to 4, discoid to subglobose, lacking trichomes. —ca. 700 spp. in temperate and tropical regions worldwide. (for James Justice, 1698–1763, Scottish horticulturist and botanist).

Justicia is the largest genus of Acanthaceae. The broad sense in which this genus is currently interpreted includes *Adhatoda* Mill., *Beloperone* Nees, *Dianthera* L., *Jacobinia* Nees ex Moric., and *Siphonoglossa* Oerst.

1. Corollas pinkish purple with white markings on lower lip; calyx 4-lobed with lobes equal in length or 5-lobed with posterior lobe greatly reduced in size.....*J. sonorae*
1' Corollas reddish (sometimes with white markings on lower lip in *J. candicans*), white, or rarely yellow; calyx 5-lobed with lobes equal to subequal in length.
   2. Corollas entirely white, the tube cylindric (expanded only near mouth), 1–1.5 mm in diameter near midpoint; perennial herbs to 3.5(–8) dm tall; pollen 3-aperturate..... *J. longii*
   2' Corollas reddish, the tube gradually expanded from near base to apex, 1.7–4 mm in diameter near midpoint; shrubs to 3 m tall; pollen 2-aperturate.
      3. Young stems ± pallid resulting from a dense and even covering of very short trichomes, the epidermis not or but barely visible; inflorescence of axillary or terminal dichasiate thyrses; dichasia pedunculate with peduncles 1–14 mm long; corollas entirely reddish or sometimes partially yellowish within (rarely entirely yellow), the lobes of lower lip 1–5.5 mm long; at least upper theca dorsally pubescent, the lower (and sometimes upper) theca with a

prominent basal appendage to 0.6 mm long; fruit pubescent; seeds subglobose to subcompressed, not red.....*J. californica*

3' Young stems glabrous or pubescent but not pallid as described above, the epidermis usually clearly visible; inflorescence of solitary dichasia in leaf axils or condensed dichasiate spikes (appearing as clusters) in leaf axils; dichasia sessile; corollas red with white markings on lower lip, the lobes of lower lip 4.5–11.5 mm long; thecae dorsally glabrous, lacking basal appendages (or rarely the lower theca with an inconspicuous basal appendage to 0.1 mm long); fruit glabrous; seeds ± discoid, usually somewhat reddish.....*J. candicans*

Justicia californica (Benth.) D. N. Gibson (for California). Chuparosa, Hummingbird Bush. —Erect or sometimes clambering shrubs to 3 m tall. YOUNG STEMS multi-grooved and terete to quadrate, densely and evenly pubescent with erect to antrorse to retrorse to appressed eglandular trichomes 0.05–0.2 mm long, these giving the stems a pallid aspect, sometimes with flexuose glandular (or rarely eglandular) trichomes to 1 mm long as well. LEAVES (often absent during anthesis) petiolate, the blades elliptic to ovate to deltate to subcircular to cordate, 7–70 mm long, 4–48 mm wide, 1–2.9 times longer than wide. INFLORESCENCES of axillary and terminal dichasiate thyrses to 135(–180) mm long, these often terminating axillary branches and collectively appearing as or forming an open terminal panicle of thyrses; dichasia usually opposite, 1-flowered, pedunculate with peduncles 1–14 mm long; bracts caducous, opposite, ovate to lance-elliptic to elliptic to obovate, 2.5–10 mm long, 1–4 mm wide; bracteoles subulate to linear, 1.5–6 mm long, 0.5–1 mm wide. FLOWERS sessile to pedicellate; calyces 5-lobed, 3–13 mm long, the lobes equal to subequal in length; corollas dark red or orange-red, sometimes partially yellowish within (rarely corolla entirely yellow), 21–41 mm long, the tube expanded distally, 2.5–4 mm in diameter near midpoint, the lobes of lower lip 1–5.5 mm long; stamens 15–19 mm long, the thecae (including basal appendage) 2–3.3 mm long, dorsally pubescent with eglandular trichomes (upper theca densely so, lower theca sparsely so to nearly glabrous), the lower (and sometimes upper) theca with a ± bulbous basal appendage to 0.6 mm long; pollen 2-aperturate, the apertures flanked on each side by 1 row of insulae. FRUITS (13–)15–24 mm long, pubescent with eglandular (and sometimes glandular) trichomes; seeds brown, subglobose to subcompressed, 2.5–3.5 mm long, 3–4.5 mm wide, smooth. $2n = 28$. (Figs. 11, 14L). [*Beloperone californica* Benth.]. — Slopes or flats, in or along watercourses, and palm oases in Sonoran desertscrub and mesquite grasslands: Gila, La Paz, Maricopa, Pima, Pinal, Yavapai, Yuma cos. (Fig. 3D); 50–1050 m (250–3500 ft); flowering Aug–May; fruiting Aug–May; s CA; nw Mex. (Baja C., Baja C. Sur, Son. Sin.).

The overall distribution of *J. californica* is nearly coterminous with that of the Sonoran Desert. The nectariferous flowers provide a major food source for several species of hummingbirds and were a source of food for pre-Columbian cultures. Peak flowering occurs in March. The species is sometimes cultivated for ornament, and the yellow-flowered form (e.g., *Windham & Yatskievych 82–95* from Yuma County) is rare.

Justicia candicans (Nees) L. D. Benson (becoming pure white). Canyon Justicia. —Erect shrubs to 1.5 m tall. YOUNG STEMS subquadrate, evenly pubescent with erect and flexuose to antrorse eglandular trichomes 0.1–1 mm long. LEAVES petiolate, the blades ovate, 13–39(–70) mm long, 7–30(–36) mm wide, 1.4–2.1 × longer than wide. INFLORESCENCES of 1-flowered dichasia or multi-flowered short spikes (sometimes appearing as clusters) in axils of distal leaves (sometimes reduced to lanceolate or ovate bracts); dichasia opposite, 1-flowered, sessile to subsessile with peduncles less than 1 mm long; bracteoles linear-subulate to linear to oblanceolate, 5–12 mm long, 0.7–3 mm wide. FLOWERS sessile to subsessile; calyces 5-lobed, 4.5–8 mm long, the lobes equal to subequal in length; corollas red with white markings on lower lip, 25–37 mm long, the tube gradually expanded distally, 2.5–3 mm in diameter near midpoint, the lobes of lower lip 5–10 mm long; stamens 15–16 mm long, the thecae (including basal appendage) 1.5–2.2 mm long, glabrous, the lower theca with a basal appendage 0.05–0.1 mm long; pollen 2-aperturate, the apertures flanked on each side by 2 or more rows of insulae. FRUITS 10–14 mm long, glabrous; seeds usually reddish, discoid, 3–4 mm long, 2.8–3.5 mm wide, smooth to ± lumpy-tuberculate. $2n = 28$. (Fig. 14J). [*Dianthera candicans* (Nees) Hemsl., *Jacobinia candicans* (Nees) B. D. Jacks., *Jacobinia ovata* A. Gray]. —Slopes and along watercourses in Sonoran desertscrub and riparian woodlands: Maricopa, Pima, Santa Cruz cos. (Fig. 4A); 450–1050 m (1500–3400 ft); flowering Oct–May (peak Mar–May), fruiting Oct–May; Mex.

The inflorescences of *Justicia candicans* consist of solitary dichasia in the leaf axils or of condensed dichasiate spikes in the leaf axils. The distal leaves bearing axillary inflorescences sometimes become reduced in size and bractlike, thereby resulting in a terminal, compound inflorescence. The species reaches the northern extent of its range in the Arizona Upland subdivision of the Sonoran Desert near Canyon Lake in Maricopa County. It is entirely absent from the Lower Colorado River Valley subdivision. It is considerably more abundant in some other subdivisions of the Sonoran Desert and in regions of thornscrub and tropical deciduous forest to the south of Arizona.

Justicia longii Hilsenb. (for Robert Long, 1927–1976, American botanist). Tube Tongue. —Perennial herbs to 3.5(–8) dm tall. YOUNG STEMS subquadrate to multi-striate, evenly pubescent with retrorse to retrorsely appressed eglandular trichomes 0.05–0.8 mm long. LEAVES subsessile to petiolate, the blades linear-lanceolate to lanceolate to elliptic to ovate, 5–70 mm long, 2–14(–18) mm wide, 2–11 times longer than wide. INFLORESCENCES of axillary, sessile to subsessile dichasia; dichasia opposite at distal leaf nodes, 1–3 (or more)-flowered, sessile to subsessile; bracteoles often subfoliose, linear to lance-elliptic, 4–24 mm long, 0.5–4.7 mm wide. Flowers sessile; calyces 5-lobed, 4–9(–12) mm long, the lobes equal in length; corollas entirely white, 31–55 mm long, the tube cylindric, 1–1.5 mm in diameter near midpoint, the lobes of lower lip 4–12 mm long; stamens 4–7 mm long, the thecae (including basal appendage) 1–2 mm long, glabrous, each with a basal appendage or the upper theca lacking an appendage, the appendages 0.2–0.3 mm long; pollen 3-aperturate, the apertures flanked on each side by 2(–3) rows of insulae. FRUITS 6.5–10 mm long, glabrous; seeds tan or orangish (immature) to dark brown, discoid, 2–2.7 mm long, 2–2.5 mm wide, bubbly-tuberculate. $2n = 28$. (Fig. 14M). [*Adhatoda longiflora* Torr.,

Siphonoglossa longiflora (Torr.) A. Gray]. —Slopes and along watercourses in Sonoran desertscrub, desert grasslands, oak-juniper chaparral, and riparian woodlands: Cochise, Graham, Maricopa, Pima, Pinal, Santa Cruz, Yavapai cos. (Fig. 4B); 500–1360 m (1700–4500 ft); flowering: Mar–Nov (peaks in Apr and Aug–Sep), fruiting all year; w TX; nw Mex. (Baja C., Son.).

Two forms are evident among the Arizona plants that correlate with the bimodal flowering of this species in spring and fall. The spring (Mar–Jun) form has plants ± leafless or with leaves smaller (to 43 mm long and to 9 mm wide) and corollas cleistogamous (budlike) or chasmogamous and mostly 20–35 mm long. The fall form (Aug–Oct) has larger leaves (to 70 mm long and to 18 mm wide) and longer chasmogamous corollas (35–55 mm long); cleistogamous flowers are not evident on fall flowering plants. Flowers of *Justicia longii* have been noted to be nocturnal, faintly fragrant, and likely visited by hawkmoths.

Justicia sonorae Wassh. (for Sonora). Sonoran Justicia. —Ascending to erect perennial herbs to 4.5 dm(–1 m) tall. YOUNG STEMS subterete to quadrate-sulcate to 6-angled, glabrous or evenly to bifariously to unifariously pubescent with flexuose to retrorse to retrorsely appressed eglandular trichomes 0.2–1 mm long, sometimes also with scattered glandular trichomes (usually restricted to distal few internodes) 0.05–0.3 mm long. LEAVES (sometimes absent during anthesis) petiolate, the blades lance-ovate to ovate (to cordate), 7–55 mm long, 3–22 mm wide, 1.3–2.8 × longer than wide. INFLORESCENCES of axillary or terminal dichasiate spikes to 15 cm long, the spikes (when several) collectively forming a terminal ± leafy panicle, the spike rachises pubescent with eglandular and glandular trichomes 0.05–0.3 mm long (glandular-pubescent); dichasia (alternate to) opposite (sometimes opposite a fertile branch), 1-flowered, sessile; bracts triangular-subulate to lance-subulate, 1–4.8 mm long, 0.8–1.5 mm wide; bracteoles lance-subulate, 1.2–3.2 mm long, 0.3–0.8 mm wide. FLOWERS sessile; calyces 4–5-lobed, 3–6 mm long, with 4 lobes equal in length, the posterior 5th lobe (if present) conspicuously shorter than others; corollas pinkish purple with white markings on lower lip, 23–37 mm long, the tube gradually expanded distally, 1.8–2.7 mm in diameter near midpoint, the lobes of lower lip 4–9 mm long; stamens 7–11 mm long, the thecae 1.2–2.2 mm long, glabrous (or sometimes the upper theca dorsally pubescent with eglandular trichomes to 0.1 mm long), lacking basal appendages; pollen 2-aperturate, the apertures flanked on each side by 2 or more rows of insulae. FRUITS 10–13.5 mm long, glandular-pubescent; seeds dark brown, 1.8–2.5 mm long, 1.4–2.3 mm wide, bubbly tuberculate. $2n = 22$. (Fig. 14I). —Slopes of riparian forest: Cochise Co. (Fig. 3C); 1100 m (3700 ft); flowering May, fruiting May; nw Mex. (Son.).

Although known from a single putatively native occurrence in Cochise County, *Justicia sonorae* is easily propagated and cultivated in southern Arizona. The description above includes information from both cultivated and native plants in Arizona.

Ruellia L. Ruellia, Wild Petunia

Decumbent to erect perennial herbs or subshrubs with cystoliths. LEAVES opposite. INFLORESCENCES of reduced or expanded dichasia in axils of leaves or

bracts, sometimes forming dichasiate spikes, thyrses, or panicles; dichasia alternate or opposite, 1–many flowered, sessile or pedunculate. FLOWERS chasmogamous (and cleistogamous), sessile to pedicellate; calyces deeply (4–)5-lobed, the lobes equal to unequal in size; corollas blue to blue-purple (rarely pinkish), the tube ± abruptly expanded distally into a ± distinct throat, the limb appearing subactinomorphic, the upper lip 2-lobed, the lower lip 3-lobed, the corolla lobes contorted in bud; corollas of cleistogamous flowers (when present) small and budlike or tubular; stamens 4, included in corolla tube (or with thecae partially emergent from mouth of corolla), the thecae of a pair parallel to subsagittate, equally inserted on filament, equal in size, lacking basal appendages, dehiscing toward lower lip; pollen spherical to subspheroidal, 3-porate and coarsely reticulate; staminodes 0 or 1. FRUITS substipitate or stipitate, the head narrowly ellipsoid to ellipsoid, lacking a medial constriction, the septa with attached retinacula remaining attached to inner wall of mature capsule; seeds to 28, discoid, pubescent with appressed hygroscopic trichomes. —Ca. 300 species worldwide, but mostly in tropical regions. (for Jean Ruelle, 1474–1537, French herbalist and physician).

1. Leaves 9–35 mm long, the surfaces with at least some trichomes branched or stellate; inflorescence of 1(–3)-flowered dichasia in leaf axils, borne on peduncles 0.5–6 mm long; bracteoles subfoliose, 6.5–18 mm long, 2–6.5 mm wide, the abaxial surface pubescent with eglandular trichomes only; calyces 5–11 mm long, externally pubescent with eglandular trichomes only, the anterior lobes usually fused for half or more of their length; fruits 9–11(–13) mm long, glabrous or pubescent with eglandular trichomes only ..... *R. parryi*

1' Leaves 20–240 mm long, the surfaces lacking any branched or stellate trichomes; inflorescence of (1–)3–many-flowered dichasia in axils of leaves and/or bracts, borne on peduncles 4–45 mm long; bracteoles not subfoliose, 2–8 mm long, 0.6–2 mm wide, the abaxial surface glabrous or with pubescence including glandular trichomes; calyces (9–)11–25 mm long, externally with pubescence including glandular trichomes, the anterior lobes not fused for half or more of their length; fruits 12–29 mm long, glandular-pubescent (at least distally).

   2. Herbs from woody underground caudex or root; inflorescences of expanded dichasia from distal leaves and bracts forming a terminal, conspicuously glandular-pubescent and paniclelike thyrse, the glandular trichomes dense, to 1 mm long (some, usually most, at least 0.5 mm long) ..... *R. ciliatiflora*

   2' Perennial herbs (at least partially woody above ground) or shrubs; inflorescences of expanded dichasia from medial and distal leaves, the glandular trichomes (when present) sparse and inconspicuous, up to 0.2 mm long ..... *R. simplex*

Ruellia ciliatiflora Hook. (ciliate-flowered). Fringe-flowered Ruellia. —Erect to ± diffuse perennial herbs to 6 dm tall from woody underground caudex or root. YOUNG STEMS quadrate to quadrate-sulcate, glabrate or sparsely pubescent with flexuose eglandular (and sometimes glandular) trichomes to 2.5 mm long (especially at nodes). LEAVES petiolate, the blades ovate to broadly ovate to elliptic, (2–)3–24 cm long, 1–11 cm wide, 1.2–3.8 times longer than wide, the surfaces lacking branched

or stellate trichomes, the margin undulate-crenate to sinuate to subdentate. INFLORESCENCES of pedunculate ascending or laterally spreading expanded dichasia (sometimes not evident) from axils of proximal leaves, and subsessile to pedunculate ± expanded and ascending dichasia from axils of distal (usually reduced) leaves and bracts, the latter dichasia collectively forming a terminal leafy sometimes basally branched paniclelike thyrse to 30 cm long and to 16 cm wide, the thyrse rachis pubescent with erect to flexuose glandular and eglandular (sometimes sparse) trichomes (glandular-pubescent); dichasia 3–7– (or more–)flowered, the peduncles 4–45 mm long, glandular-pubescent; bracts subfoliose near base of terminal thyrse, distal bracts linear to linear-lanceolate, 4–16 mm long, 0.5–2 mm wide; bracteoles lance-linear to lanceolate to subulate, 2–7 mm long, 0.6–1.4 mm wide. FLOWERS subsessile to pedicellate with pedicels to 9 mm long; calyces (9–)11–20(–25 in fruit) mm long, the lobes subequal in size (or with 1 ± conspicuously longer than others), the anterior lobes not fused for half or more of their length; corollas (25–)30–50 mm long, externally glandular-pubescent, the lobes (6–)10–13 mm long; stamens 7–13 mm long, the thecae 2.7–3.5 mm long. Fruits 12–22 mm long, glandular-pubescent; seeds to 16, 3–4 mm long, 2.5–3.5 mm wide. $2n = 34$. (Figs. 12, 14K). [*Ruellia nudiflora* (Engelm. & A. Gray) Urb.]. —Along watercourses and in floodplains, swales, and other seasonally wet areas in Sonoran desertscrub, Chihuahuan desertscrub, semidesert grasslands, and mesquite bosques: Cochise, Maricopa, Pima, Santa Cruz cos. (Fig. 4C); 550–1250 m (1850–4200 ft); flowering Apr–Oct (peak Aug–Sep), fruiting Mar–Nov; s USA; Mex.; C. Amer.; S. Amer.

This species has long been known in the southwestern United States and Mexico as *R. nudiflora*. In addition to its occurrence in the four counties of Arizona noted above, it undoubtedly also occurs in southwestern Pinal Co. (several collections from Pima Co. were made within a few kilometers of Pinal Co.). Occurrences in the United States from states other than Arizona and Texas likely represent naturalized plants (see Daniel 2013). Although morphological variation in this widely distributed species is considerable, plants from Arizona are rather homogeneous. They show seasonal variation with early-flowering plants bearing proximal axillary pedunculate dichasia (or thyrses) bearing cleistogamous flowers, and later-flowering plants (usually after summer rains) bearing a terminal glandular thyrse with chasmogamous flowers.

Ruellia parryi A. Gray (for Charles Parry, 1823–1890, American botanist). Parry's Ruellia. —Erect subshrubs to 6 dm tall. YOUNG STEMS quadrate-sulcate, glabrous or pubescent with retrorse eglandular trichomes 0.05–0.2 mm long, the nodes often with a cluster of flexuose eglandular trichomes to 1.3 mm long. LEAVES petiolate, the blades ovate to lance-elliptic to elliptic to oblanceolate to obovate, 9–25(–35) mm long, 3–15 mm wide, 1.7–2.8(–7) times longer than wide, the surfaces pubescent with at least some branched or stellate trichomes, the margin entire to undulate. INFLORESCENCES of pedunculate dichasia in leaf axils; dichasia 1(–3)-flowered, the peduncles 0.5–6 mm long, glabrous or pubescent like young stems; bracteoles subfoliose, ovate to lanceolate to elliptic to obovate, 6.5–18 mm long, 2–6.5 mm wide. FLOWERS sessile; calyces 5–11 mm long, the lobes unequal in size, the anterior segments usually fused for half or more of their length into a longer/wider and apically 2-lobed anterior segment; corollas 20–23 (up to 50 extralimitally) mm long,

externally pubescent with eglandular trichomes, the tube abruptly expanded distally into throat, the lobes 5–13 mm long; stamens 5–9 long, the thecae 1.8–2 mm long. FRUITS 9–11(–13) mm long, (glabrous) pubescent (at least distally) with eglandular trichomes; seeds to 8, 2.5–3 mm long, 1.9–2.2 mm wide. —Limestone slopes in Chihuahuan desertscrub: Cochise Co. (Fig. 4A); 1350 m (4500 ft); flowering Apr, fruiting unknown in AZ; s NM, w TX; n Mex.

Because this species is known from a single collection from Arizona (*Chamberland 1900*, ARIZ), the description above has been augmented with information from plants in nearby regions.

Ruellia simplex Wright (simple or unbranched). Mexican Wild Petunia. — Erect to ± diffuse perennial herbs (to shrubs) to 1 m tall. YOUNG STEMS quadrate-sulcate, glabrous or sparsely pubescent with flexuose eglandular trichomes to 1.8 mm long, the nodes pubescent with a cluster of flexuose eglandular trichomes to 2.5 mm long. LEAVES petiolate, the blades narrowly elliptic to elliptic, 27–131 mm long, 6–45 mm wide, 2.9–6.3 times longer than wide, the surfaces glabrous or sparsely pubescent with simple eglandular trichomes, the margin undulate-crenate. INFLORESCENCES of expanded pedunculated dichasia in leaf axils; dichasia (1–)3–many-flowered, the peduncles 17–30 mm long, glabrous or distally pubescent with inconspicuous glandular trichomes to 0.2 mm long (glandular-puberulent); bracteoles often caducous, lanceolate, 3.5–8 mm long, 0.8–2 mm wide. FLOWERS pedicellate; calyx 17–21 mm long, the lobes equal to subequal in size, the anterior segments not fused for half or more of their length; corollas 50–57 mm long, externally puberulent with eglandular and glandular trichomes, the lobes 13–14 mm long; stamens 10–13 mm long, the thecae 2.7–4 mm long. FRUITS 17–29 mm long, glabrous proximally, sparsely puberulent with glandular (and eglandular) trichomes at apex; seeds to 28, 2.1–3.2 mm long, 2–2.5 mm wide. $2n = 34$. [*Ruellia brittoniana* Leonard, *R. coerulea* Morong, *R. malacosperma* Greenm.]. —Watercourses and disturbed sites, naturalized: Maricopa Co. (Fig. 2C); 350–650 m (1150–2200 ft); flowering May–Jul, Oct, fruiting Jul, Oct.; s USA (naturalized); Mex.; C. Amer.; W. Ind.; S. Amer.

The native distribution of this widely cultivated species remains uncertain. As interpreted here, *R. simplex* consists of plants with narrow, lance-linear leaves (6.5–40 × longer than wide), previously usually cited as *R. brittoniana*, and plants with wider, narrowly elliptic to elliptic leaves (2.3–5.8 × longer than wide), often treated as *R. malacosperma*. Some plants have leaves intermediate between these types, or possess both types on the same individual. Both "forms" are cultivated in Arizona, but only the wider-leaved plants are currently known to be naturalized in the state.

Tetramerium Nees

Decumbent to erect perennial herbs or shrubs with cystoliths. LEAVES opposite. INFLORESCENCES of terminal conspicuously and usually densely bracteate 4-sided unbranched dichasiate spikes; dichasia opposite, 1–3-flowered, sessile. FLOWERS sessile; calyces deeply 4-lobed (in ours), the lobes equal; corollas with tube subcylindric, the throat indistinct or distinct only near mouth, the limb pseudopapilionaceous with upper lip comprising 2 fused lobes and lower lip 3-lobed,

the lateral lobes similar to one another, the lower-central lobe conduplicate (keel-like) and enclosing stamens and often style during anthesis, the corolla lobes ascending cochlear in bud; stamens 2, exserted from mouth of corolla, the thecae of a pair parallel to subsagittate, equally inserted, equal to subequal in size, lacking basal appendages, dehiscing toward upper lip; pollen ellipsoid, 3-colporate, 6-pseudocolpate; staminodes 0. FRUITS stipitate, the head ellipsoid to obovoid, lacking a medial constriction, the septae with attached retinacula separating slightly from inner wall of mature capsule. Seeds to 4, plano-convex, lacking trichomes. —29 spp. warm temperate and tropical regions of sw N. Amer.; C. Amer.; S. Amer. (Greek: *tetra*, four + *merus*, parted, in reference to the 4-sided inflorescences).

Tetramerium nervosum Nees (full of nerves referring to prominent veins of bracts). Hairy Fournwort. —Sprawling to erect perennial herbs to 3(–5) dm tall. YOUNG STEMS terete to subquadrate, pubescent with eglandular (and rarely glandular) trichomes 0.2–1 mm long. LEAVES petiolate, the blades narrowly lanceolate to ovate, 10–45(–70) mm long, 2–16(–32) mm wide, 2–5.4 × longer than wide. INFLORESCENCES of densely bracteate 4-sided terminal spikes to 7 cm long and 8–20 mm across near midspike, the rachis not visible; bracts lance-ovate to ovate to elliptic, 7–15 mm long, 3.5–5 mm wide, twisted-spreading distally, conspicuously mucronate at apex; bracteoles lance-subulate, 2.5–5 mm long. FLOWERS with calyces 2.5–4.5 mm long; corollas whitish to cream-yellow with blue and purple markings on upper lip, 12–17 mm long; stamens 5–5.5 mm long, the thecae 1–1.4 mm long. FRUITS 4–5.5 mm long, pubescent with eglandular trichomes; seeds blackish, 1.5–2 mm long, 1–1.8 mm wide, covered with barbed tubercles. $2n = 36$. (Fig. 13, 14N). [*Dianthera sonorae* S. Watson, *Tetramerium hispidum* Nees, *Tetramerium nervosum* var. *hispidum* Torr.]. —Slopes, along watercourses, and disturbed areas in desert grasslands, mesquite grasslands/bosques, chaparral, oak woodlands, and riparian forests: Cochise, Graham, Pima, Pinal, Santa Cruz cos. (Fig. 4D); 900–1600 m (2900–5200 ft); flowering Apr–Oct (peak Aug–Sep), fruiting Apr–Dec; s NM, w TX; Mex.; C. Amer.; S. Amer.

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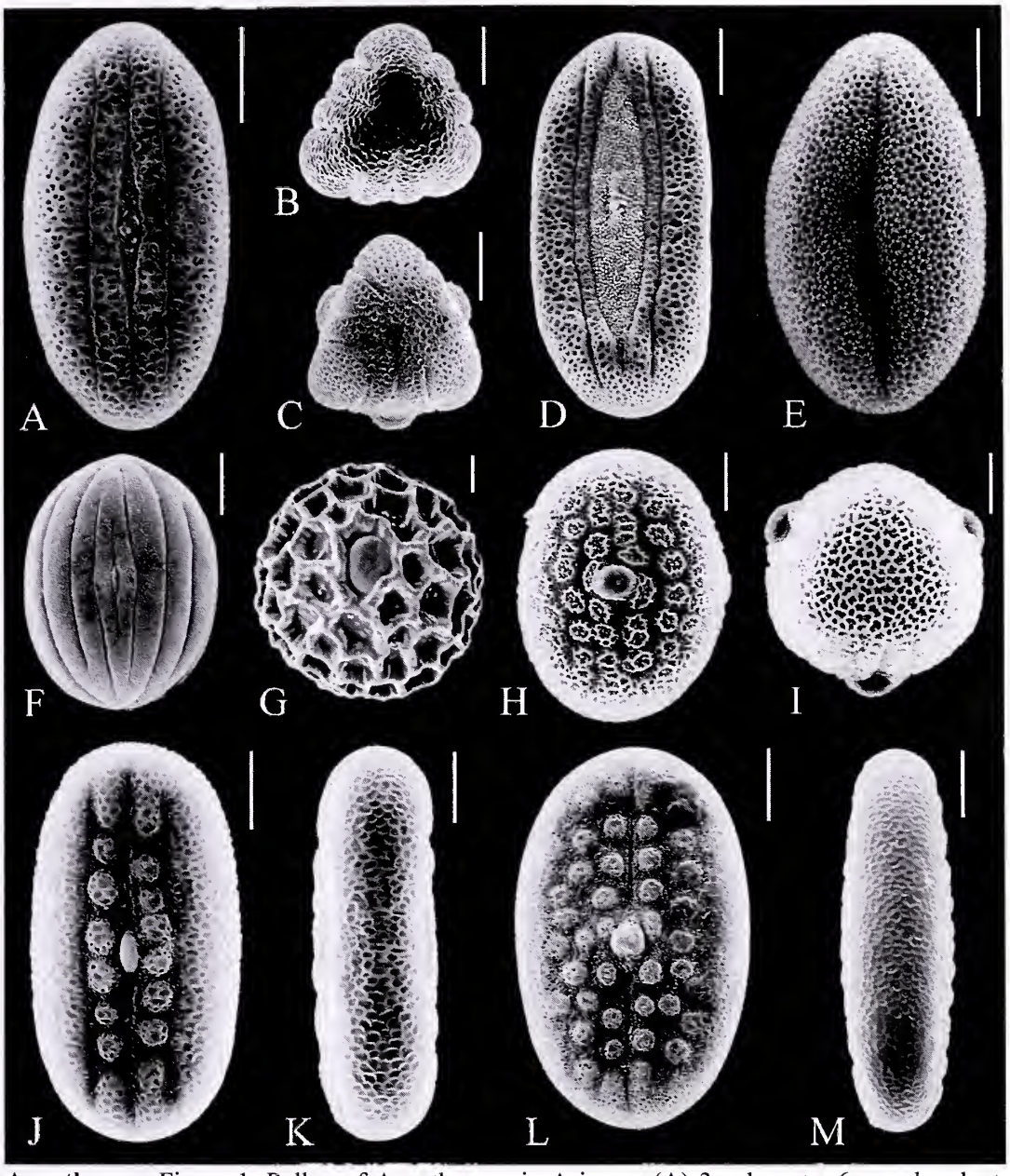
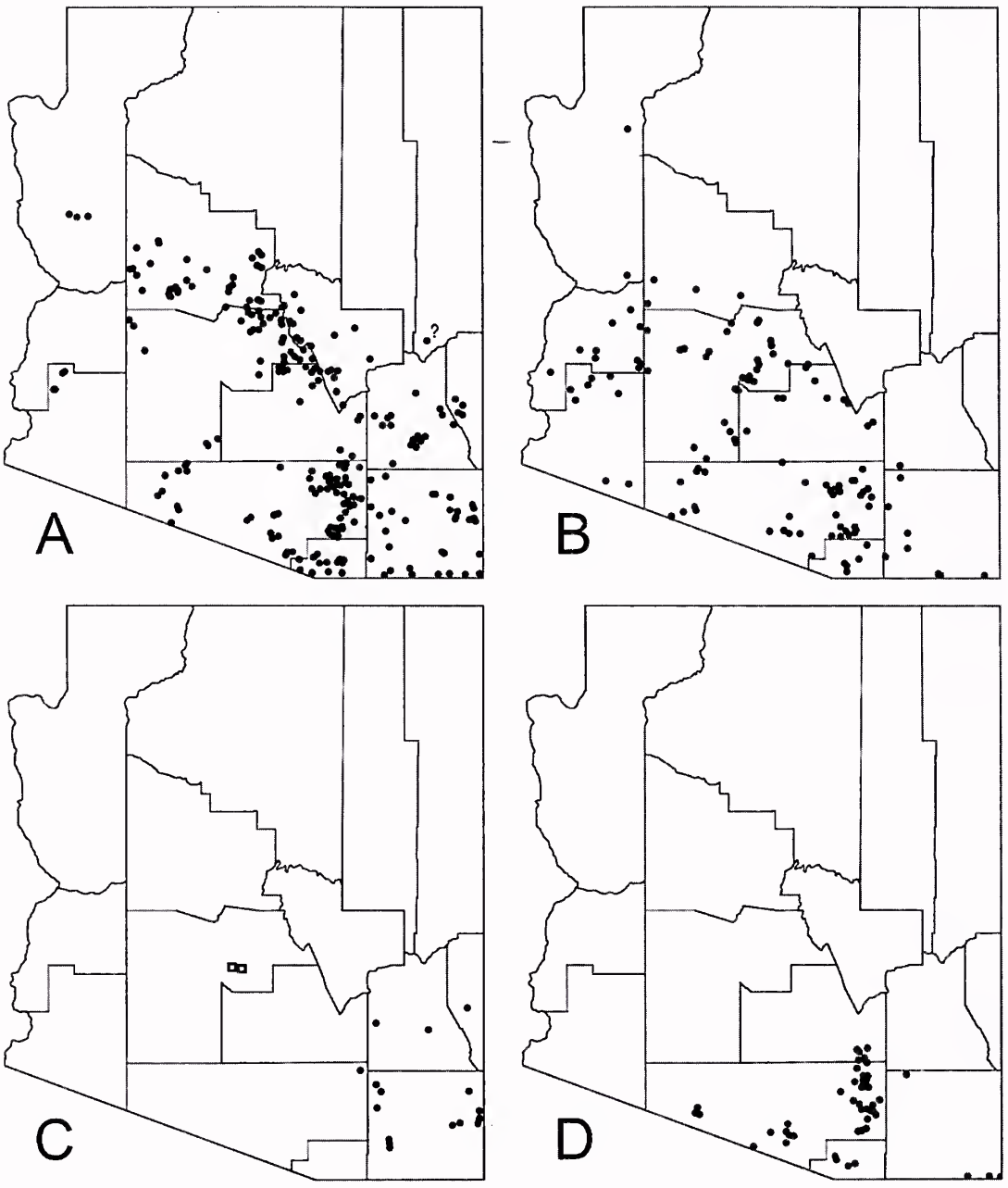
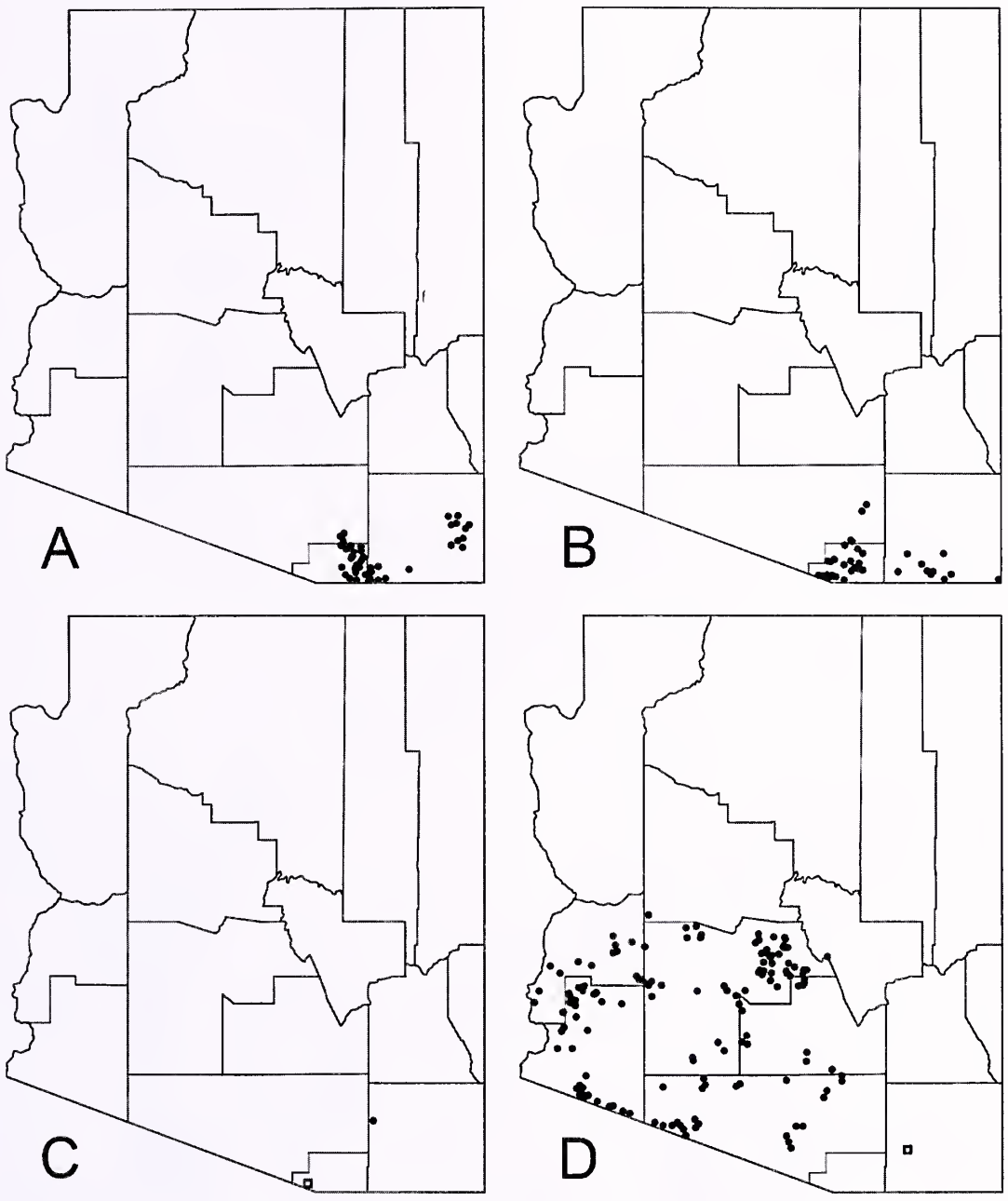


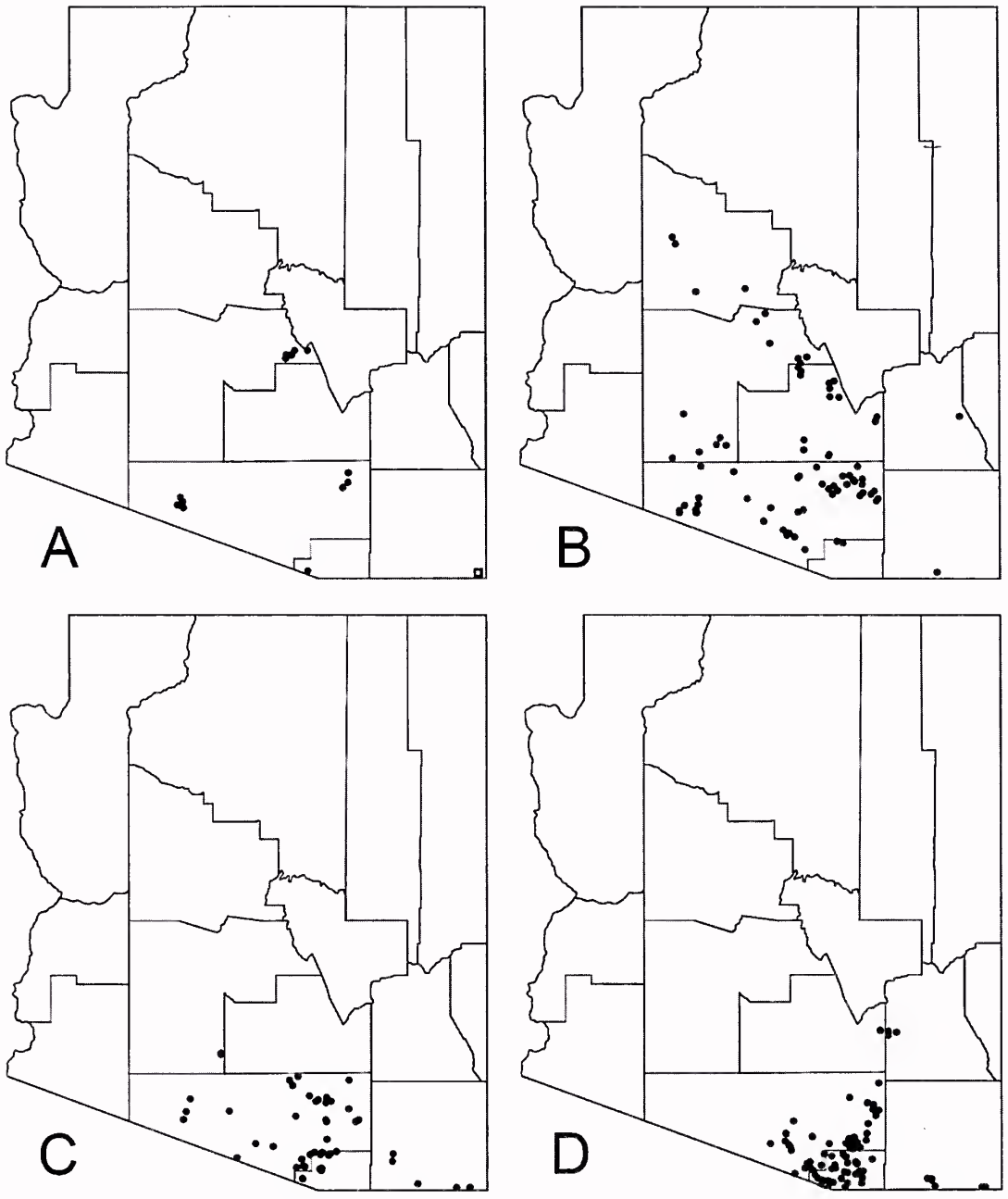
Acanthaceae Figure 1. Pollen of Acanthaceae in Arizona. (A) 3-colporate, 6-pseudocolpate pollen with narrow colpi, equatorial-apertural view (*Carlowrightia arizonica*; characteristic of *Anisacanthus*, *Carlowrightia*, *Dicliptera*, and *Tetramerium*); (B) same as A, polar view; (C) 3-colporate, 6-pseudocolpate pollen with broad colpi, polar view (*Henrya insularis*); (D) same as C, equatorial-apertural view; (E) 3-colpate pollen (*Elytraria imbricata*); (F) 3-colporate and polypseudocolpate pollen, equatorial-apertural view (*Dyschoriste decumbens*); (G) 3-porate and coarsely reticulate pollen, equatorial-apertural view (*Ruellia simplex*; characteristic of all Arizona *Ruellia*); (H) 3-aperturate pollen with 2–3 rows of insulae on each side of aperture, equatorial-apertural view (*Justicia longii*); (I) same as H, polar view; (J) 2-aperturate pollen with 1 row of insulae on each side of aperture, equatorial-apertural view (*Justicia californica*); (K) same as J, equatorial-interapertural view; (L) 2-aperturate pollen with 2–3 rows of insulae on each side of aperture, equatorial-apertural view (*Justicia candicans*; also characteristic of *J. sonorae*); (M) same as L equatorial-interapertural view.



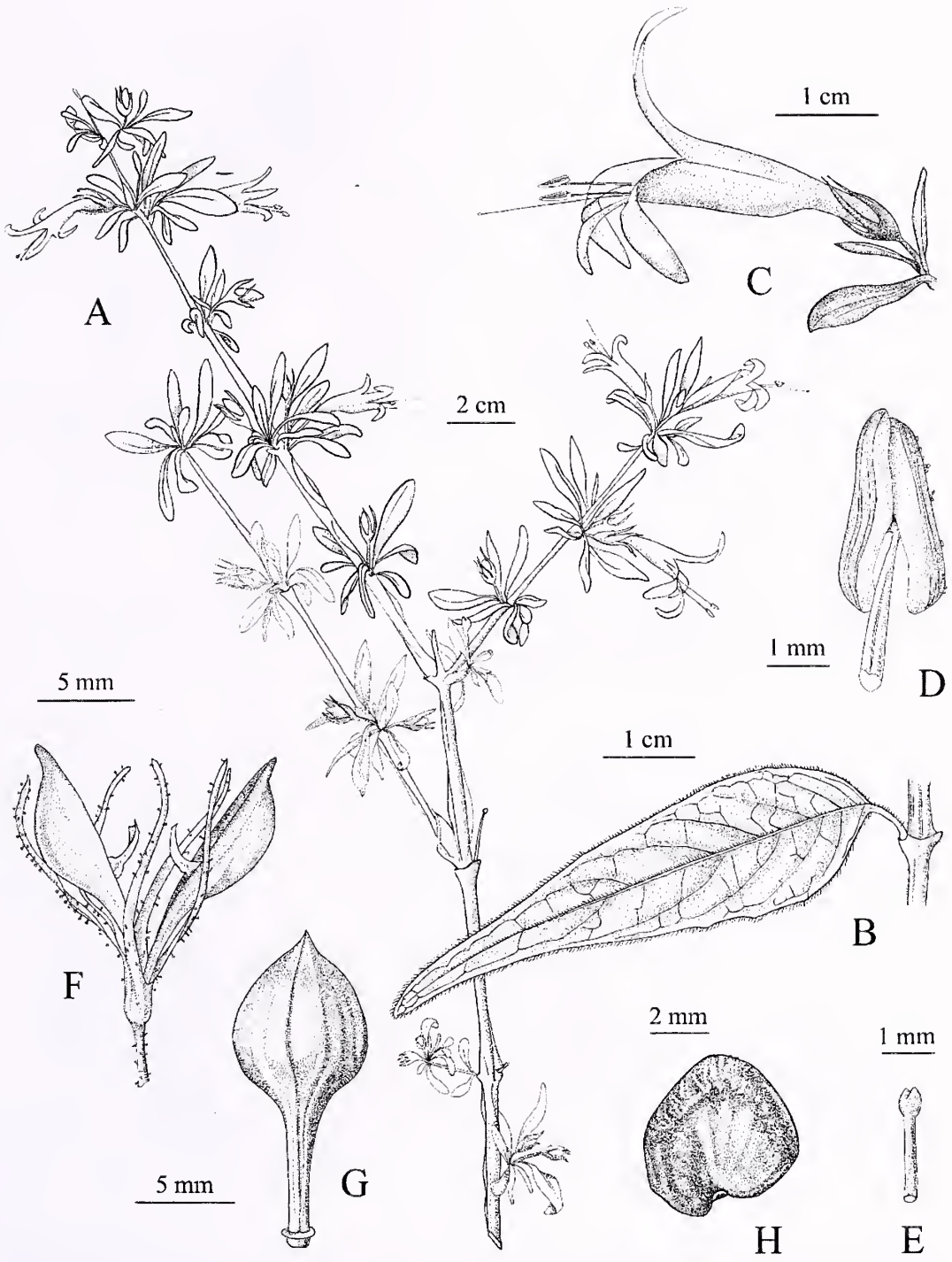
Acanthaceae Figure 2. Distributions. (A) *Anisacanthus thurberi*; (B) *Carlowrightia arizonica*; (C) *Carlowrightia linearifolia* (circles) and *Ruellia simplex* (open squares); (D) *Dicliptera resupinata.*



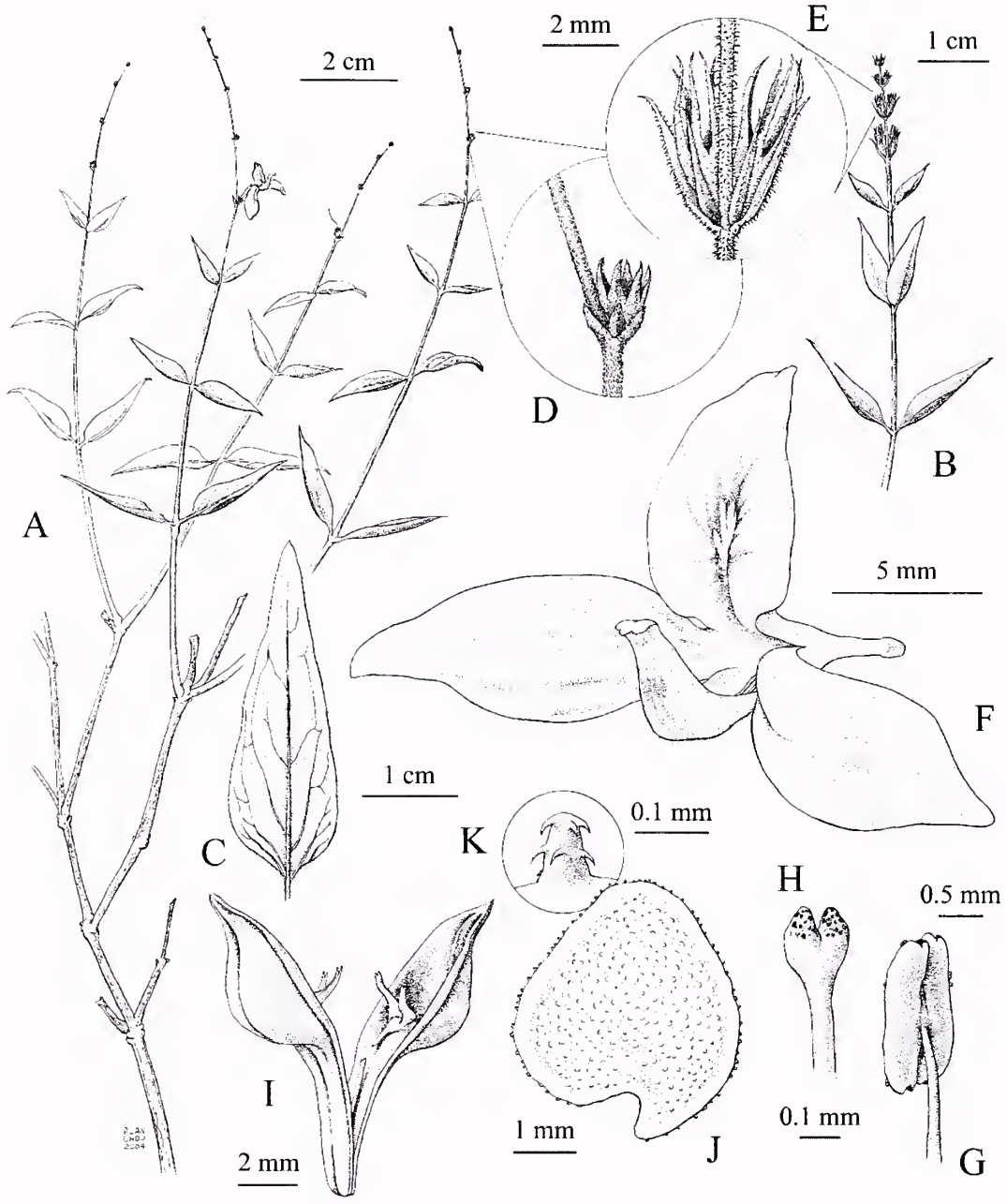
Acanthaceae Figure 3. Distributions. (A) *Dyschoriste decumbens*; B. *Elytraria imbricata*; C. *Henrya insularis* (open square) and *Justicia sonorae* (circle); (D) *Justicia californica* (circles) and *Carlowrightia texana* (open square).



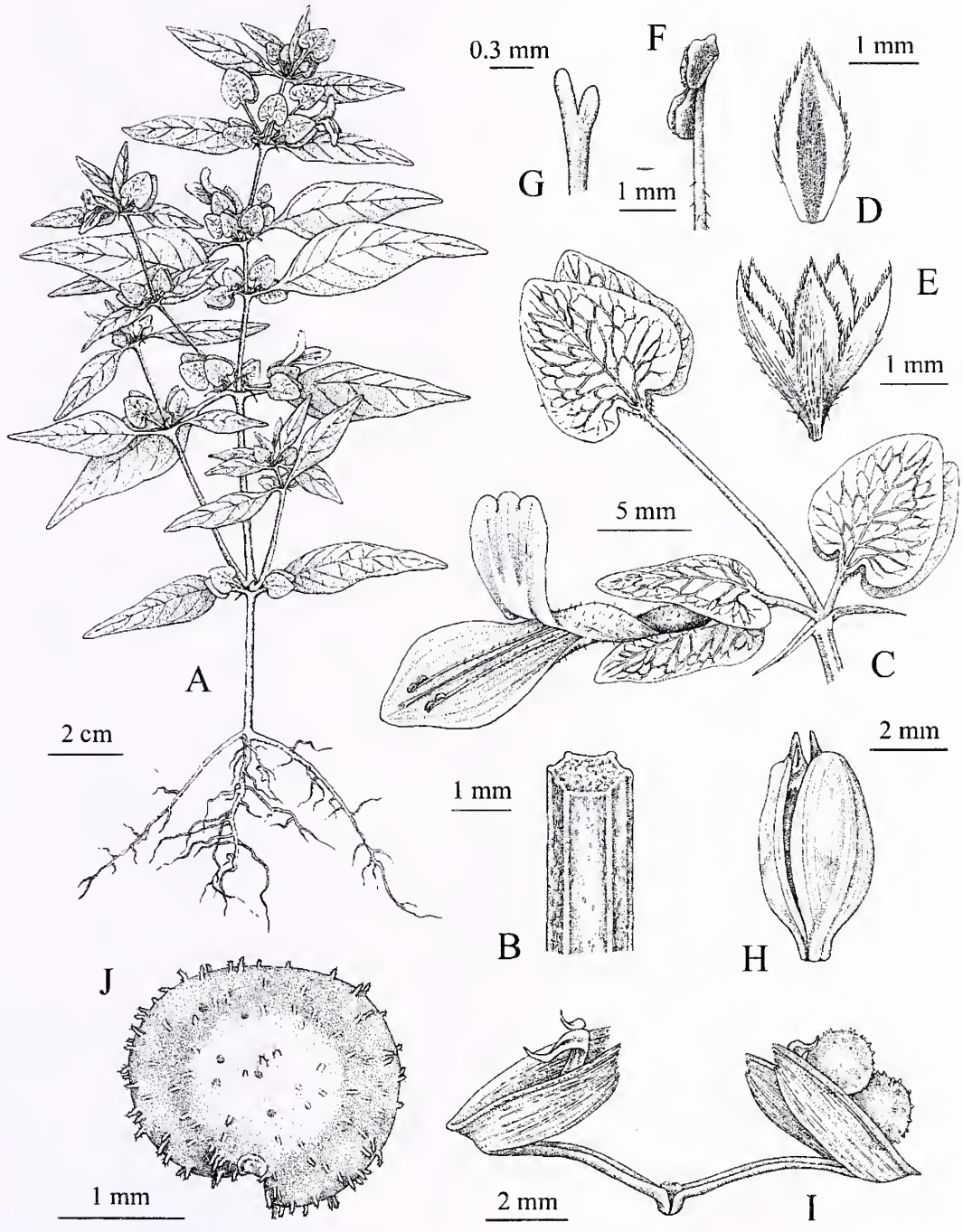
Acanthaceae Figure 4. Distributions. (A) *Justicia candicans* (circles) and *Ruellia parryi* (open square); (B) *Justicia longii*; (C) *Ruellia ciliatiflora*; (D) *Tetramerium nervosum*.



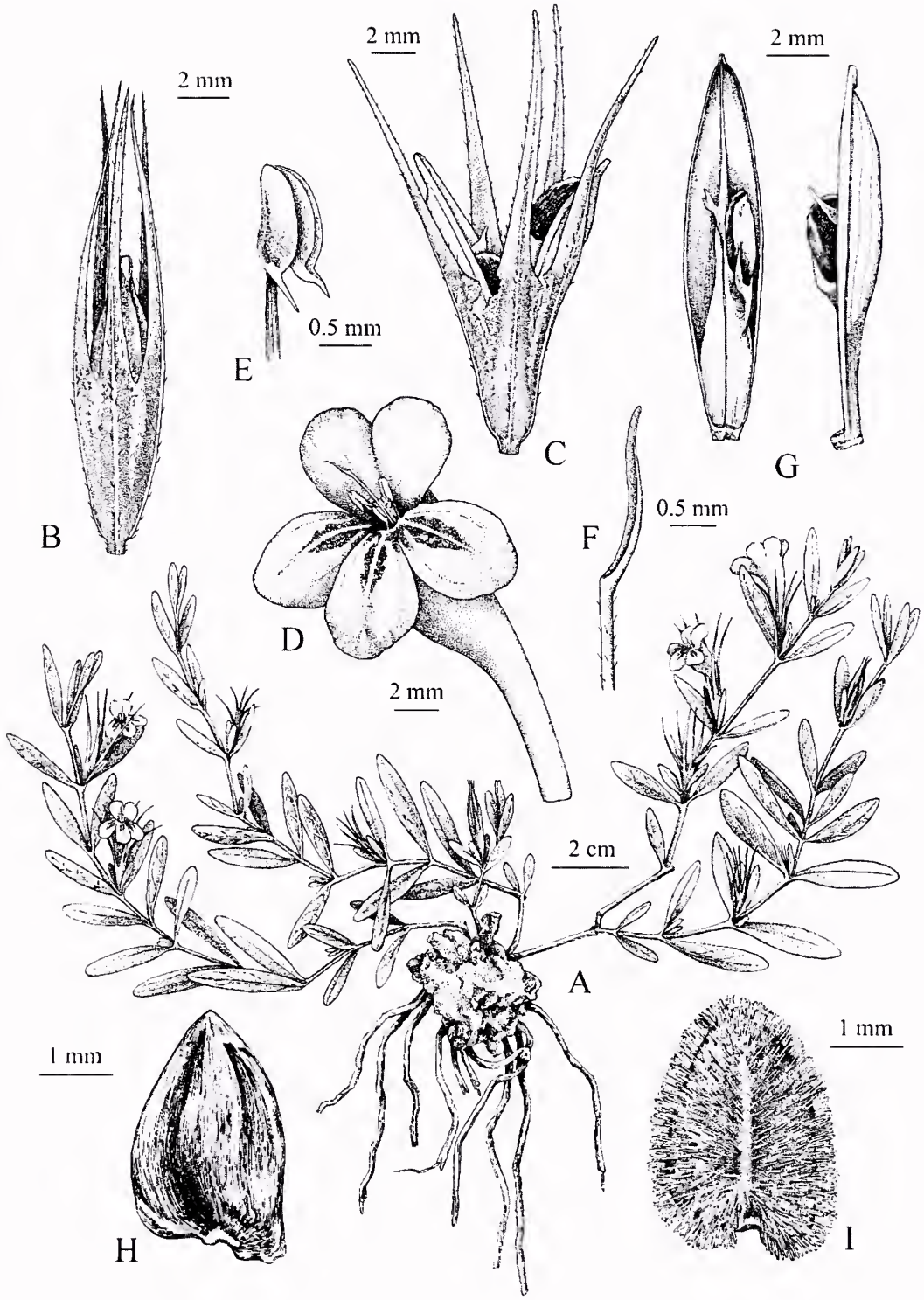
Acanthaceae Figure 5. *Anisacanthus thurberi*. (A) habit; (B) leaf; (C) dichasium (bract, bracteoles, and flower); (D) apex of filament with anther; (E) apex of style with stigma; (F) calyx with opened capsule showing retinacula; (G) closed capsule; (H) seed. Modified from Proc. Calif. Acad. Sci. 55: 711. 2004. Drawn by Z. Deretsky.



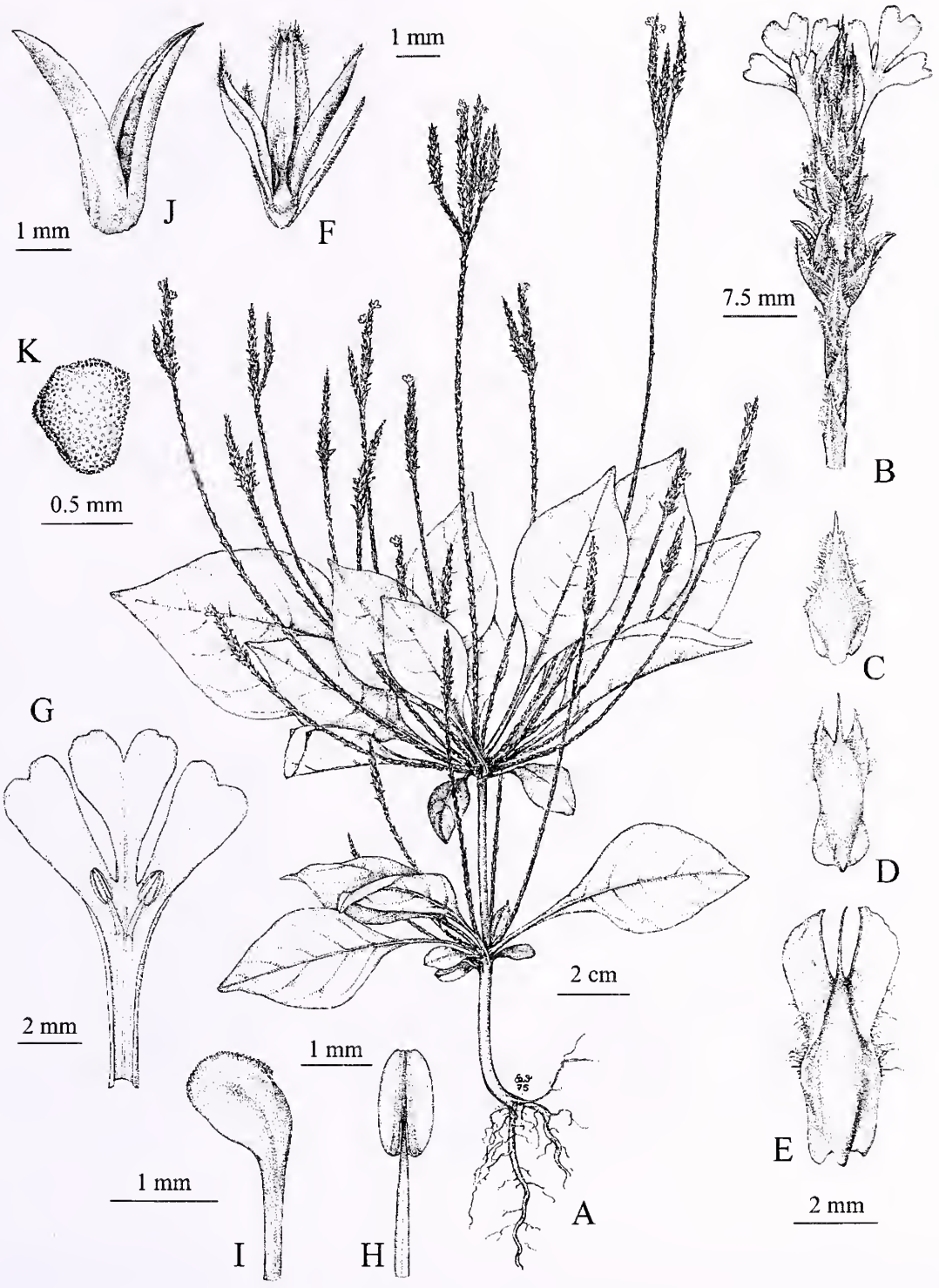
Acanthaceae Figure 6. *Carlowrightia arizonica.* (A) habit (type form); (B) habit (form with stout spikes bearing opposite dichasia); (C) leaf; (D) inflorescence node with calyx (type form); (E) inflorescence node bearing opposite dichasia with calyces (form with stout spikes); (F) corolla; (G) apex of filament with anther; (H) apex of style with stigma; (I) opened capsule showing retinacula; (J) seed; (K) tubercle from margin of seed. Drawn by A. Chow.



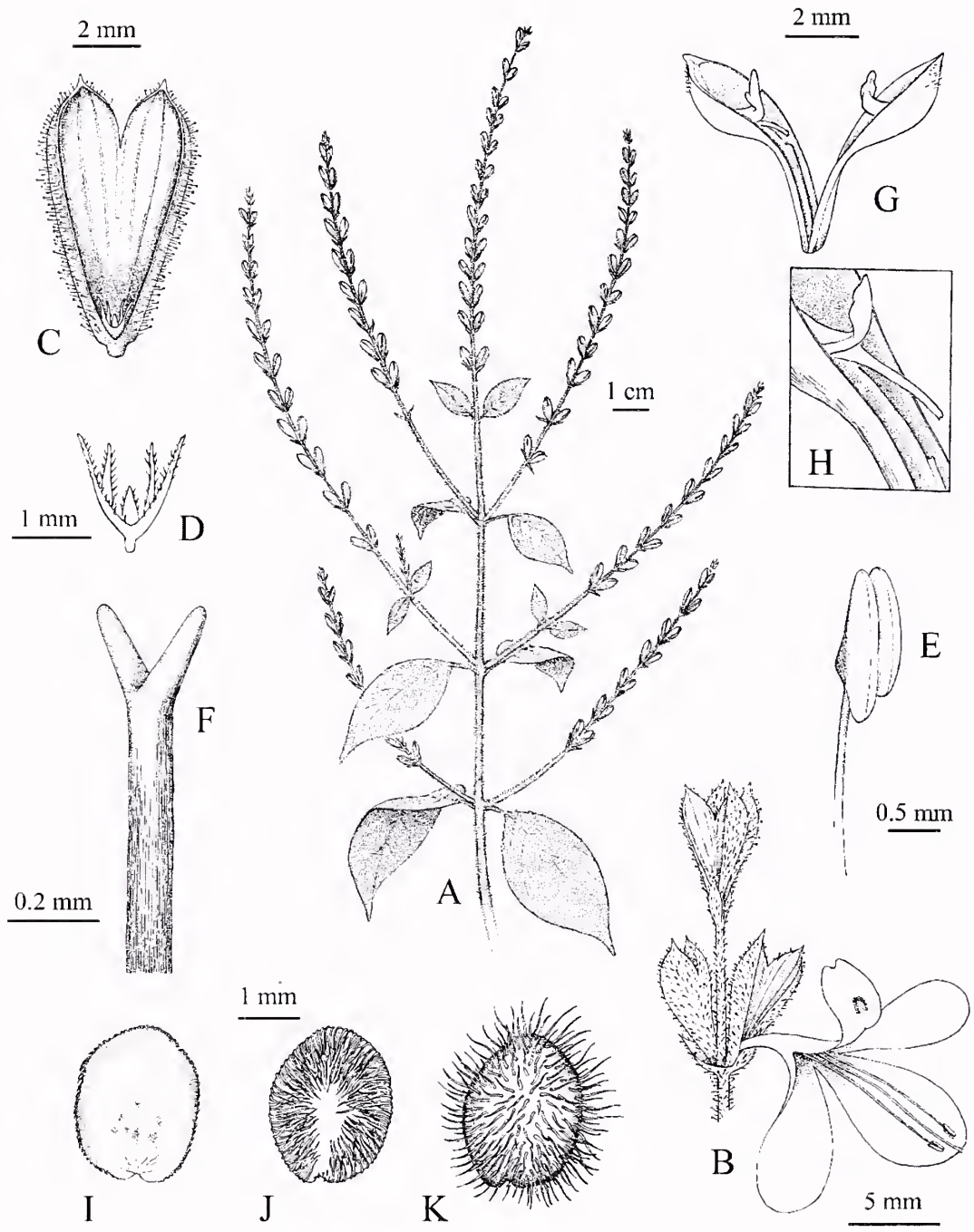
Acanthaceae Figure 7. *Dicliptera resupinata*. (A) habit; (B) segment of young stem; (C) cyme with three cymules, showing pairs of outer cymule bracteoles and a resupinate corolla; (D) inner cymule bracteole; (E) calyx; (F) apex of filament with anther showing superposed thecae; (G) apex of style with stigma; (H) slightly opened capsule; (I) fully opened capsule showing breakage; (J) seed. Modified from Proc. Calif. Acad. Sci. 49: 331.1997. Drawn by J. Speckels.



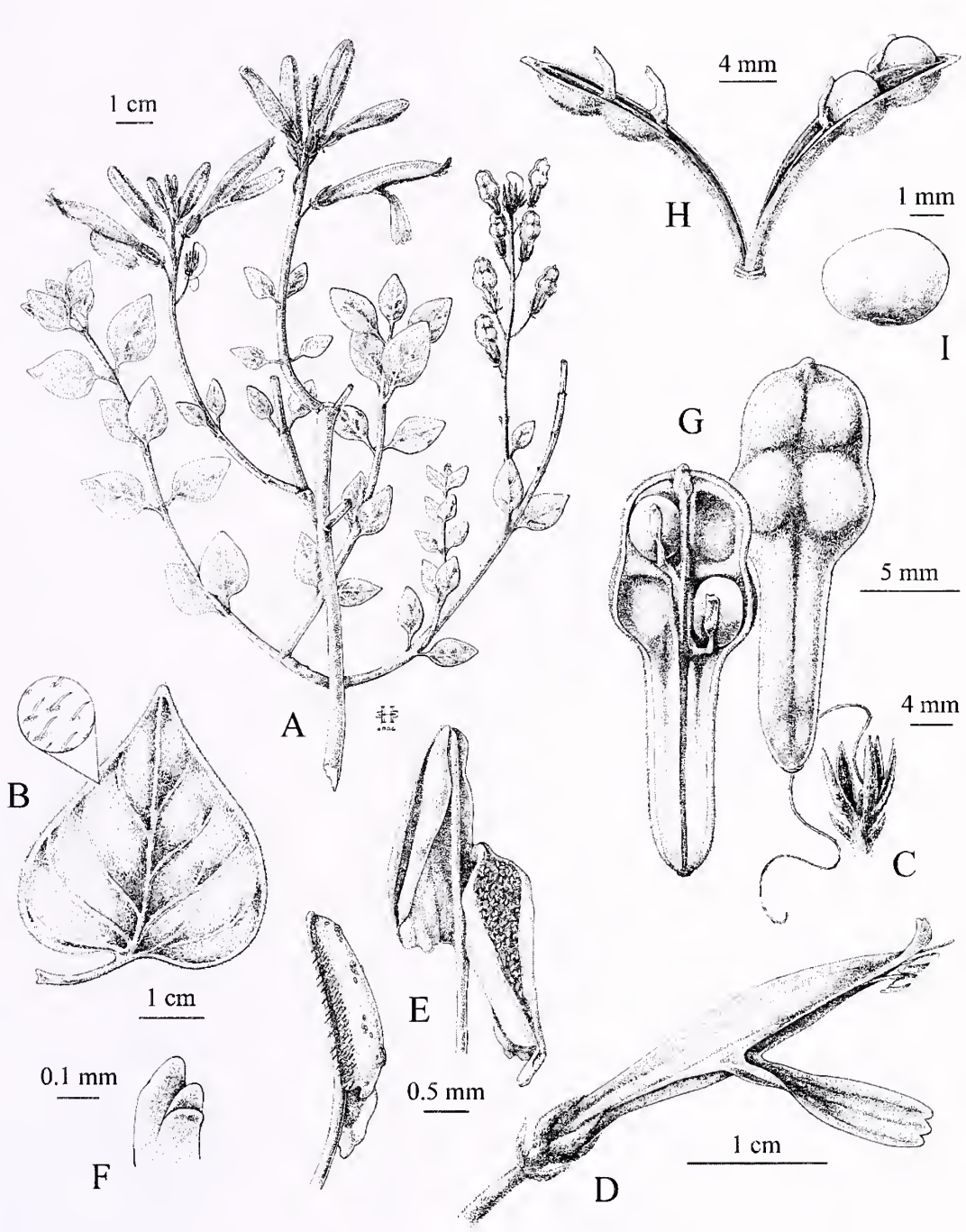
Acanthaceae Figure 8. *Dyschoriste decumbens*. (A) habit; (B) calyx with unopened capsule; (C) calyx with opened capsule; (D) flower with calyx removed; (E) apex of filament with anther; (F) apex of style with stigma; (G) capsule valves (view from side on right, view into valve on left); (H) seed (dry); (I) seed (wet) showing hygroscopic trichomes. Modified from Proc. Calif. Acad. Sci. 49: 337. 1997. Drawn by J. Speckels.



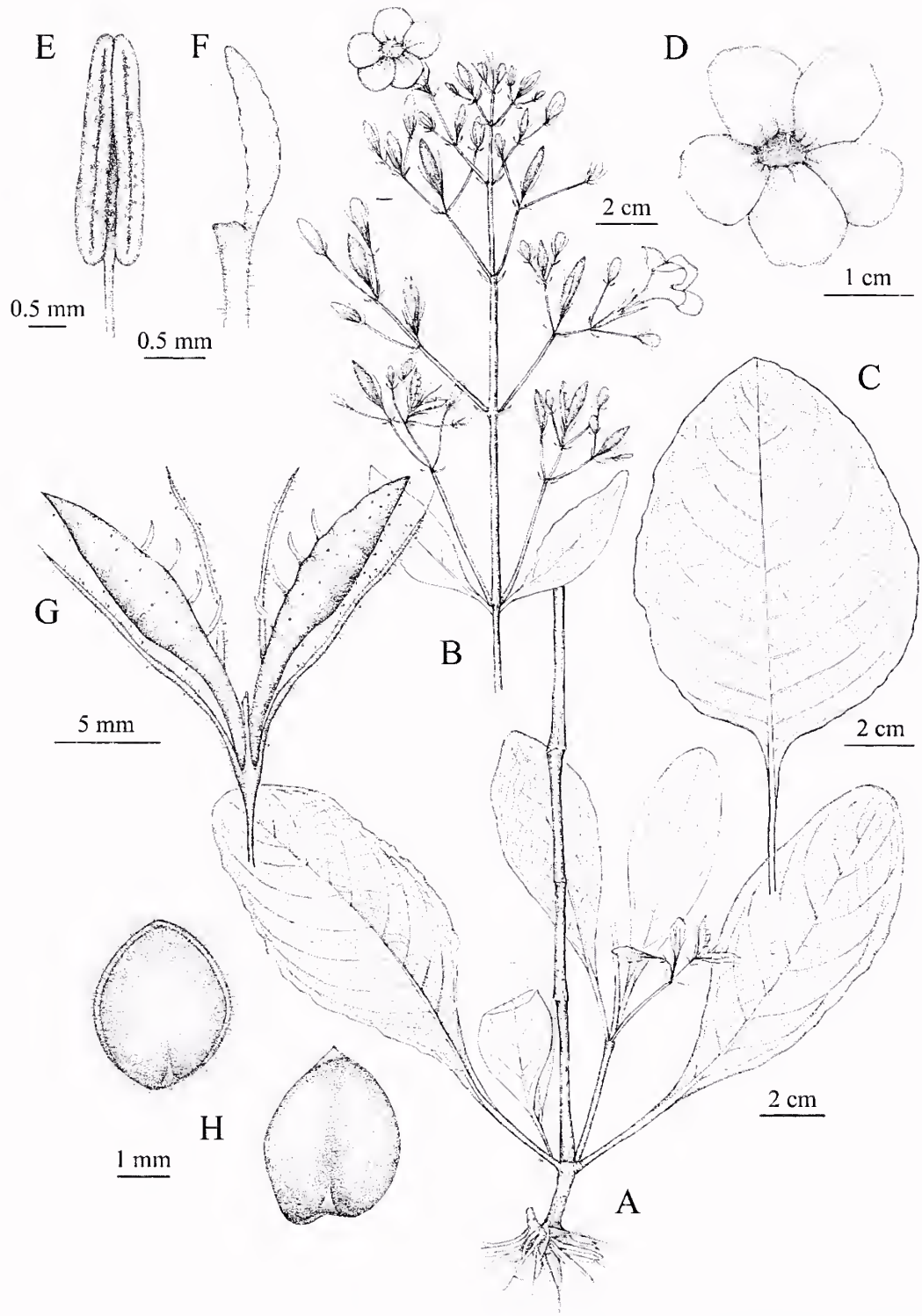
Acanthaceae Figure 9. *Elytraria imbricata*. (A) habit; (B) inflorescence; (C) bract from base of inflorescence; (D) bract showing subapical teeth; (E) bract showing greater development of subapical teeth; (F) bracteoles and calyx; (G) corolla from above with upper lip removed to show stamens; (H) stamen; (I) apex of style with partially folded stigma; (J) opened capsule; (K) seed. Modified from Fl. Chiapas 4: 38. 1995. Drawn by K. Douthit, copyright reserved to University of Michigan Herbarium; used with permission.



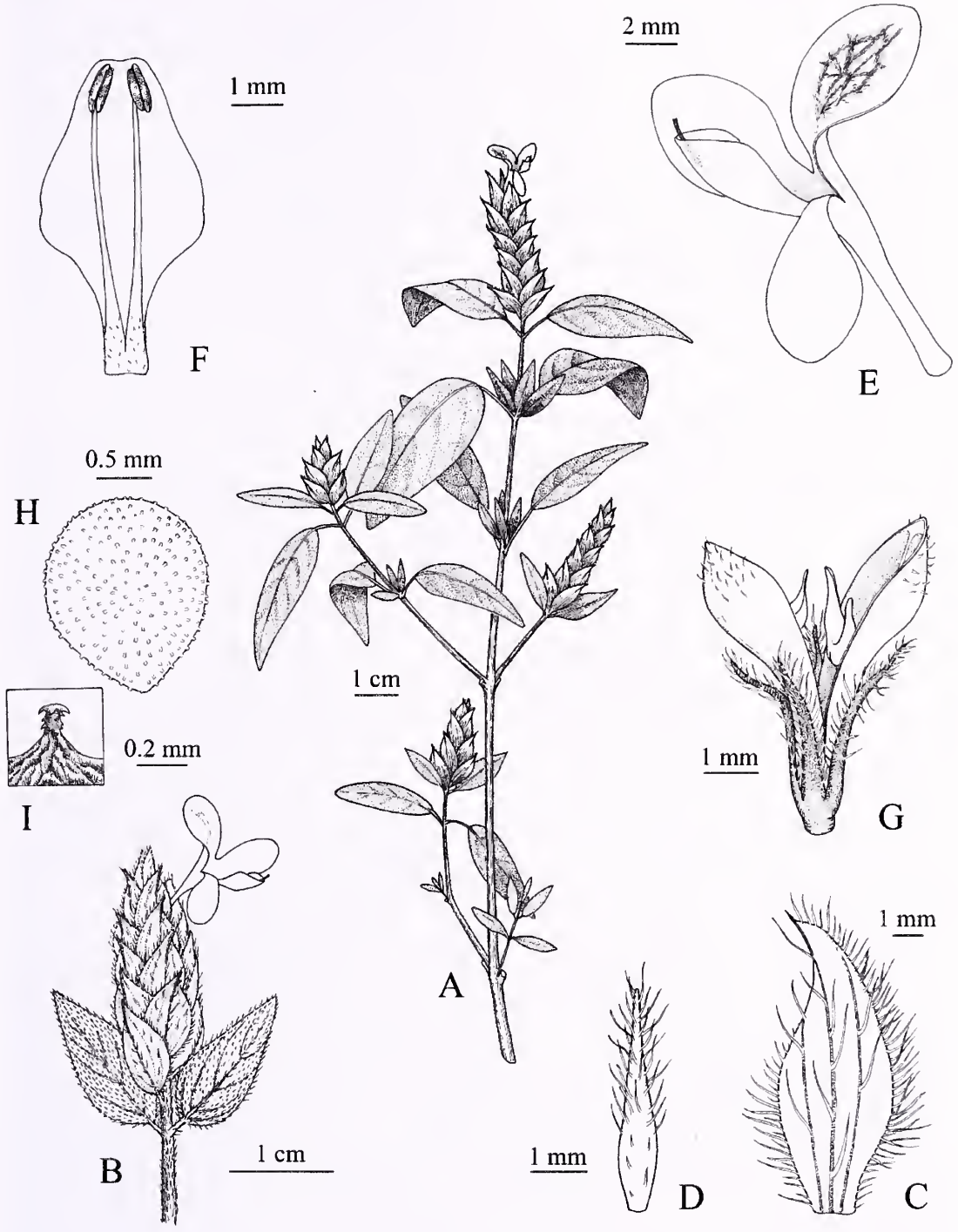
Acanthaceae Figure 10. *Henrya insularis*. (A) habit; (B) inflorescence nodes with one dichasium bearing a flower; (C) bracteoles showing fusion and calyx at base; (D) calyx; (E) apex of filament with anther; (F) apex of style with stigma; (G) opened capsule showing retinacula; (H) enlargement of inside of capsule valve showing breakage of septum bearing retinaculum; (I) flat surface of seed (dry); (J) convex surface of seed (dry); (K) convex surface of seed (wet) showing hygroscopic trichomes. Modified from Proc. Calif. Acad. Sci. 49: 345. 1997. Drawn by E. del Valle and J. Speckels.



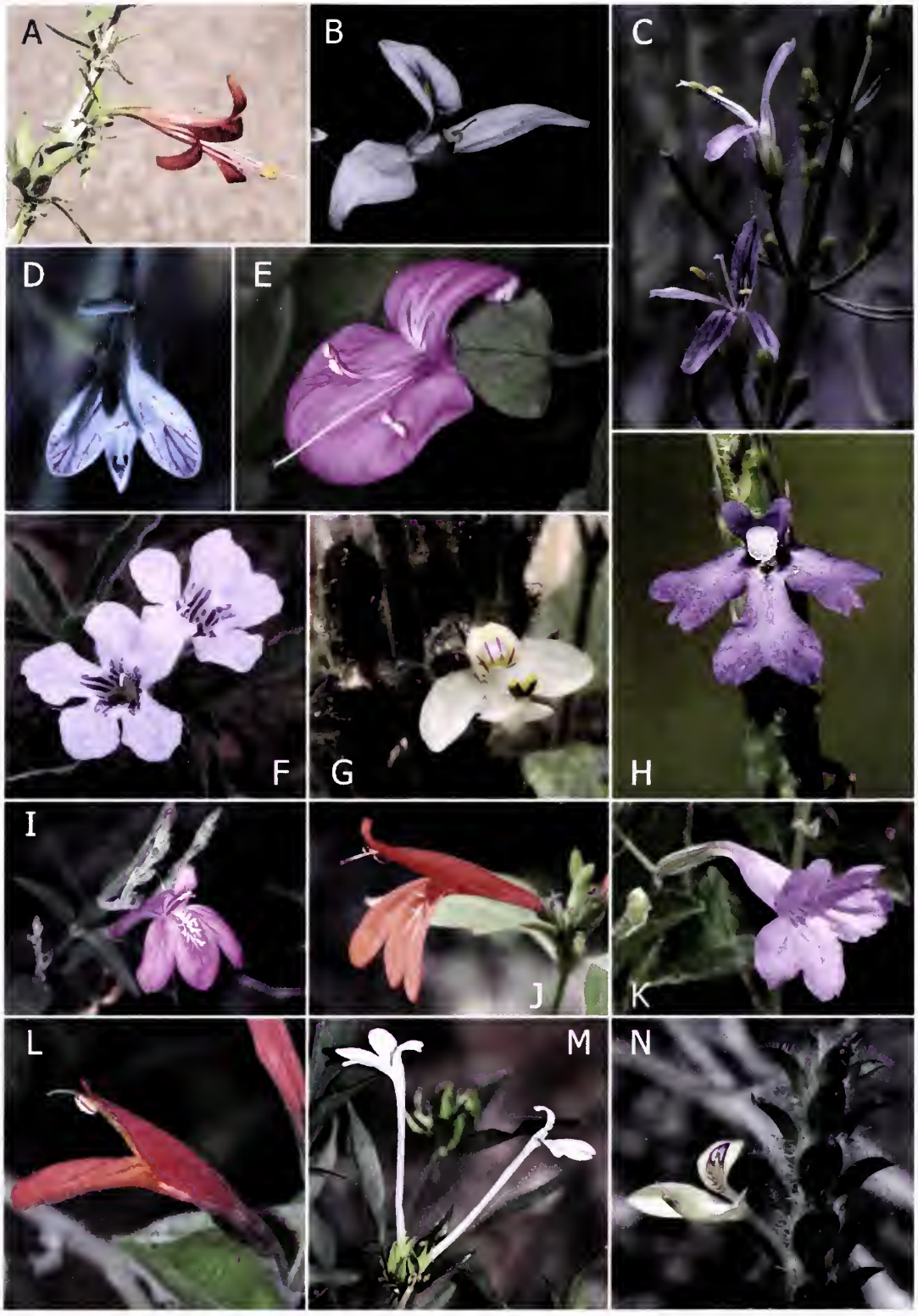
Acanthaceae Figure 11. *Justicia californica*. (A) habit; (B) leaf with enlargement showing pubescence; (C) dichasium with bracteoles, calyx, and gynoecium; (D) dichasium with bracteoles and flower; (E) apex of filament with anther showing unequally inserted thecae (front view on right, side view on left); F; stigma; (G) capsule valves (outside view on right, inside view showing retinacula and seeds on left); (H) capsule opened with two seeds removed; (I) seed. Drawn by E. Hunter.



Acanthaceae Figure 12. *Ruellia ciliatiflora*. (A) base of plant with lateral dichasium bearing cleistogamous flowers; (B) apex of plant with dichasia bearing chasmogamous flowers; (C) leaf; (D) corolla (front view); (E) apex of filament with anther; (F) apex of style with stigma; (G) calyx (front lobe partially removed) with opened capsule showing retinacula; (H) seed (dry on right, wet on left showing hygroscopic trichomes). Modified from Proc. Calif. Acad. Sci. 55: 785. 2004. Drawn by N. Strasser.



Acanthaceae Figure 13. *Tetramerium nervosum*. (A) habit; (B) inflorescence; (C) bract; (D) bracteole; (E) flower with calyx removed; (F) lower-central lobe of corolla from above (spread open to show enclosed stamens); (G) calyx with opened capsule; (H) seed; (I) enlargement of tubercle from seed. Modified from Fl. Chiapas 4: 146. 1995. Drawn by E. del Valle.



Acanthaceae Figure 14. Flowers. (A) *Anisacanthus thurberi*; (B) *Carlowrightia arizonica*; (C) *Carlowrightia linearifolia*; (D) *Carlowrightia texana*; (E) *Dicliptera resupinata*; (F) *Dyschoriste decumbens*; (G) *Henrya insularis*; (H) *Elytraria imbricata*; (I) *Justicia sonorae*; (J) *Justicia candicans*; (K) *Ruellia ciliatiflora*; (L) *Justicia californcia*; (M) *Justicia longii*; (N) *Tetramerium nervosum*. H and M courtesy of J. Rebman, used with permission.

CUCURBITACEAE GOURD FAMILY

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Herbaceous vines (or compact tufted herbs in some cultivars of *Cucurbita*), annuals or perennials from taproot or fibrous or tuberous roots, monoecious or dioecious. STEMS climbing or trailing, glabrous or variously pubescent, often scabrous. TENDRILS usually one at each node, branched or unbranched. LEAVES alternate, usually petiolate (occasionally sessile in *Sicyosperma*), the blades simple, entire to angular to variously lobed or pedately compound; stipules absent. INFLORESCENCES fascicles, racemes, panicles, corymbs, solitary or paired in leaf axils, the pistillate flowers more commonly solitary than the staminate flowers. FLOWERS small or large, regular, mostly pentamerous, the hypanthium and corolla white, yellow, or greenish yellow in ours, the calyx lobes usually green; in staminate flowers hypanthium very shallow to elongated, rotate to campanulate to funnelform to subcylindric; in pistillate flowers that portion of the hypanthium prolonged beyond the ovary rotate to campanulate to funnelform to subcylindric; calyx lobes 5(–6), borne on hypanthium rim, sometimes vestigial; corolla lobes 5(–6), borne on hypanthium rim or petals connate into a corolla tube and with 5(–6) distinct lobes; stamens 3 or 5, in ours, inserted on hypanthium, the filaments, when present, free or united into a column, the anthers free, coherent, or connate, the thecae straight or variously bent or folded or united in a horizontal ring (*Cyclanthera*); ovary inferior, the carpels (2–)3(–5); style 1, the stigmas 1–3, each 2–3-lobed. FRUITS variable in type, shape and size, dry or fleshy, armed or unarmed, indehiscent or variously dehiscent; fruit types include: pepos (indehiscent fleshy, many seeded fruits with a thick or thin rind; *Cucurbita*, *Lagenaria*, *Apodanthera*, *Citrullus*, *Cucumis*), berries (*Ibervillea*, *Tumamoca*), dehiscent capsules (*Cyclanthera*, *Brandegea*, *Echinocystis*, *Marah*, *Echinopepon*), and dry, single-seeded, indehiscent fruits (*Sicyos*, *Sicyosperma*); seeds variable in size and number, smooth or rough or sculptured, with or without differentiated margins. —About 120 genera, 825 spp. (14 genera, 21 species in AZ), chiefly in warm or tropical regions in both hemispheres. A family of great economic importance, yielding the world's melons, squashes, pumpkins, cucumbers, and gourds. This account includes 9 introduced species in 5 genera that occur here as rare, spontaneous escapes. The species cultivated for food are *Citrullus lanatus*, *Cucumis anguria*, *Cucumis melo*, *Cucumis sativus*, *Cucurbita maxima*, *Cucurbita moschata*, and *Cucurbita pepo*. *Lagenaria siceraria* and *Echinocystis lobata* are planted as ornamentals.

Vascular Plants of Arizona: Cucurbitaceae Gourd Family *Canotia* 12:55-85. 2016. ©Mary Butterwick.

1. Flowers white....2
   2. Flowers 40–55 mm long; leaves with a pair of large, marginal, annular glands at base of leaf blades; fruits 100–500 mm long, woody at maturity, smooth.... ***Lagenaria***
   2' Flowers <15 mm long; leaves without glands at base of leaf blades; fruits ≤50 mm long, not woody at maturity, echinate (except *Sicyosperma*)....3
      3. Fruits indehiscent....4
         4. Fruits solitary or in racemes, each fruit subtended by and enveloped in sessile bracts, glabrous.... ***Sicyosperma***
         4' Fruits clustered on a common peduncle, without bracts, conspicuously echinate with retrorsely barbed bristles.... ***Sicyos***
      3' Fruits variously dehiscent....5
         5. Fruits operculate; prickles stipitate glandular.... ***Echinopepon***
         5' Fruits not operculate; prickles glabrous....6
            6. Fruits asymmetric, oblique....7
               7. Leaves 3-foliolate; anther thecae fused into a ring; fruits 16–23 mm long.... ***Cyclanthera***
               7' Leaves 3–5-lobed; anther thecae horse-shoe shaped, distinct; fruits 9–11 mm long.... ***Brandegea***
            6' Fruits symmetric, not oblique....8
               8. Plants perennial; sepals and petals 5; fruits beaked; seeds ovoid, the margins grooved, the surfaces smooth.... ***Marah***
               8' Plants annual; sepals and petals 6; fruits not beaked; seeds strongly flattened, the margins not differentiated, the surfaces pitted-roughened.... ***Echinocystis***
1' Flowers yellow or greenish-yellow....9
   9. Fruits soft, fleshy, red, indehiscent; seeds arillate....10
      10. Plants dioecious; corolla lobes puberulent, bifid at apex; seeds tumid, rounded at apex, the lateral faces smooth or variously textured, not tuberculate-rugose, the margins prominent, raised; thickened root often solitary.... ***Ibervillea***
      10' Plants monoecious; corolla lobes glabrous, acute at apex; seeds compressed, truncate at apex, the lateral faces tuberculate-rugose, without differentiated margins; thickened roots often clustered.... ***Tumamoca***
   9' Fruits various, if fleshy and indehiscent, not red; seeds not arillate....11
      11. Staminate flowers in racemes or fascicles; pistillate flowers solitary....12
         12. Plants perennial; leaves reniform, wider than long, the margins undulate; fruits hard-shelled at maturity; seeds with broad, flat margins.... ***Apodanthera***
         12' Plants annual; leaves various, not reniform with undulate margins; fruits not hard-shelled at maturity; seeds without differentiated margins.... ***Cucumis***

11' Staminate and pistillate flowers solitary 13
13. Flowers of moderate size, perianth ≤ 20 mm long; flesh of fruits juicy, sweet; seeds black ..... ***Citrullus***
13' Flowers large, perianth > 50 mm long; fruits firm-fleshed or fibrous, neither juicy nor sweet; seeds variously colored, usually white to light beige, not black in ours ..... ***Cucurbita***

Apodanthera Arn. Melon Loco

Perennial vines from tuberous roots, dioecious or monoecious. STEMS trailing or climbing. TENDRILS simple or 2-branched. LEAVES with blades entire or shallowly to deeply lobed, variously pubescent. STAMINATE flowers in racemes or corymbs in leaf axils; corolla yellow; anthers 3, free or coherent, sessile, one anther 1-celled, two anthers 2-celled. PISTILLATE flowers in different axils from the staminate flowers, solitary in ours; perianth similar to that of staminate flowers; style surrounded at base by an annular disk, the stigmas 3. FRUITS pepos, ovoid to oblong to subspherical, hard-shelled at maturity, longitudinally ribbed or striped, smooth or nearly so, many-seeded; seeds ovate, slightly flattened in ours, with a broad flattened margin. The roots of *Apodanthera biflora* Cogn. ("yuca del monte") of Peru and Ecuador are edible after cooking. *Apodanthera undulata* is a source of seed oil (Earle and Jones 1962). —Ca. 19 spp. (1 in AZ) in warm sw U.S.; Mex.; C. Amer.; S. Amer. (Greek: *a* = without + *podos* = foot + Latin: *anthera* = anther)

Apodanthera undulata A. Gray var. ***undulata*** (wavy, in reference to leaf margin). —Strong-smelling vines from large, fleshy roots, monoecious. STEMS coarse, usually trailing, 3–5 mm in diameter, with appressed, spreading, and undulate hairs to 0.75 mm long, occasionally muriculate. TENDRILS simple or 2-branched. LEAVES with blades reniform, 28–102 mm long, very shallowly lobed, dentate, or only with undulate-crisped margins, the upper surfaces sparsely to densely strigose, the lower surfaces often cinereous and prominently muriculate along veins. STAMINATE flowers subtended by linear bracts 6–19 mm long; hypanthium subcylindric, 11–33 mm long; calyx lobes linear-lanceolate, 4–12 mm long; corolla tube absent, the lobes 17–27 mm long. PISTILLATE flowers solitary in leaf axils; hypanthium subcylindric, 20–24 mm long; calyx lobes linear-lanceolate, 10–12 mm long; corolla tube absent, the lobes 23–24 mm long. FRUITS yellowish at maturity, subspherical, often 10-ribbed, 65–70 mm in diameter, 65–76 mm long; seeds beige to light brown, 12–13 mm long, 8.5–9 mm wide. $2n = 28$. (Fig. 10A, B). —Along roadsides, on alluvial terraces, arid plains and mesas: Cochise, Graham, Maricopa, Pima, Pinal, Santa Cruz, Yavapai cos. (Fig. 1A); 500–1850 m (1500–5500 ft); May–Oct; NM, TX; Mex. (Chih., Coah., Dur., Son.).

Brandegea Cogn. Desert Starvine

Perennial vines from taproot, monoecious. STEMS climbing, slender, 0.3–1.5 mm in diameter, sulcate, glabrous or occasionally with white scale-like protuberances 0.2–0.8 mm long on angles. TENDRILS simple. LEAVES with blades ovate to circular

in outline, usually deeply 3–5-lobed, the upper surfaces scabrous with short strigose hairs 0.1–0.3 mm long from prominent white crystalline bases, the lower surfaces glabrous and punctate, the lobes linear, triangular, or ovate, mucronate, entire, the central lobe 6–40(–75) mm long. STAMINATE flowers 11–16 in glabrous racemes or panicles 6–15 mm long; hypanthium shallowly campanulate or rotate, <1 mm long; calyx lobes 0.1 mm long; corolla white, the tube absent, the lobes 5, 1–1.8 mm long, 0.5–1 mm wide at base, the upper surface papillate; stamens 3, the anthers horseshoe-shaped, distinct but sessile on a short column of fused filaments. PISTILLATE flowers solitary or in pairs at nodes; hypanthium not prolonged beyond ovary; calyx and corolla similar to that of staminate flowers; ovary oblique, long-rostrate, the ovule 1(–2), the style 0.1–0.2 mm long, the stigma 1, hemispherical, 0.5 mm wide. FRUITS capsules, oblique, slightly compressed laterally, beaked, 9–11 mm long, sparsely echinate with antrorse prickles 0.4–1.3 mm long; seeds brown, 1(–2), clavate, muriculate, 5 mm long, 2.5 mm wide, 1 mm thick. Monospecific genus. (for Townshend Stith Brandegee, 1843–1925, California botanist, explorer and collector, civil engineer, topographer).

Brandegea bigelovii (S. Watson) Cogn. (for Jacob Bigelow, 1787–1879, American botanist and physician) (Fig. 5A, 10D). —Along washes in sandy and clay-loam alluvium, often climbing on *Prosopis*, *Atriplex*, and *Parkinsonia*: La Paz, Maricopa, Pima, Yuma cos. (Fig. 1B); 500 m or lower (1500 ft); Dec–May; s CA; Mex. (Son., Baja C.). Reportedly collected in Pinal Co. near the Maricopa Co. line.

Citrullus Schrad. Watermelon, Citron, Preserving Melon

Annual vines from fibrous roots, monoecious. STEMS climbing or trailing, villous. TENDRILS 2–3-branched. LEAVES with blades ovate to lanceolate-ovate to ovate-triangular, 3–5-lobed, 30–200 mm long, the upper surfaces hirsute, hispid on veins, the lower surfaces glabrous or scabrous with translucent dots, the lobes pinnately shallowly sinuate-lobulate. STAMINATE flowers solitary; hypanthium campanulate, 2–4 mm long; calyx lobes 5, lanceolate, 3–5 mm long; corolla yellow, 6–16 mm long, the tube connate in proximal ½, the lobes 5; stamens 3, the filaments distinct, the thecae distinct, replicate, forming a head. PISTILLATE flowers similar to that of staminate flowers; style 1, short-columnar, the stigmas 3, each 2-lobed. FRUITS pepos, green, yellow, or variegated green and whitish or green and yellow, +/– longitudinally striped, globose or subglobose to ellipsoid, smooth; seeds 50–300+, ovoid to oblong, compressed, the margin not differentiated, the surface smooth. —5 spp. (1 in AZ) in Afr.; Asia; introduced widely. (Latin: *citrus* = citron-tree, a plant of the Rutaceae + *ule* = a diminutive suffix, alluding to resemblance of fruits).

Due to the paucity of materials from Arizona, much of the data in both the generic and species descriptions herein are based on Nesom (2015).

Citrullus lanatus (Thunb.) Matsum. & Nakai (woolly). Watermelon. — LEAVES with blades ovate to lanceolate-ovate or ovate-triangular, mostly 80–200 mm long. FRUITS green, mottled with paler green and yellowish to whitish stripes, globose to oblong-ellipsoid, 120–350+ mm in diameter, the rind tough, not durable, the mesocarp red to orange, yellow, or greenish, juicy, sweet; seeds black, ovoid to oblong

ovoid, 7–15 mm long. $2n = 22$. (Fig. 8B). —Spontaneous escape along rivers and margins of lakes and ponds: Apache, Cochise, Greenlee, Maricopa, Mohave, Pima, Santa Cruz, Yavapai cos. (Fig. 4C); 900–1750 m (3000–5700 ft); Aug–Nov; introduced in AL, AR, CA, CT, FL, GA, IL, KA, KY, LA, ME, MD, MA, MI, MS, MO, NV, NJ, NM, NY, NC, OH, OK, PA, RI, SC, TN, TX, UT, VT, VA, NV, WI; Asia; Afr.; Mex.; W. Ind.; C. Amer.; S. Amer; Eur.; Australia. Widely cultivated. A report of 5000-year old seeds of *Citrullus lanatus* in Libya indicates its domestication might have occurred in northern Afr. (Wasylikowa and Van der Veen 2004).

Cucumis L. Melon, Cucumber

Annual or perennial vines from taproot, monoecious. STEMS trailing or climbing, sulcate, hispid or retrorse-strigose. TENDRILS solitary, simple. LEAVES with blades ovate to broadly ovate in outline, entire or palmately 3–6-lobed, variously pubescent. STAMINATE flowers in fascicles, racemes, or panicles; hypanthium campanulate or funnelform; calyx lobes 5; corollas yellow, the tube funnelform, the lobes 5, elliptic to ovate to obovate; anthers free. PISTILLATE flowers usually solitary; portion of hypanthium fused to ovary ellipsoid to cylindrical; calyx lobes 5; corolla yellow, the tube when present funnelform, the lobes elliptic or obovate; style 1, short-columnar, the stigma 1, lobate with finger-like projections. FRUITS pepos, variously colored, ellipsoid, cylindric, globose, ovoid or obovoid, surface prickly or not; seeds yellowish-white, many, elliptic to ovate, compressed, smooth, without a differentiated margin. —Ca. 52 spp. (3 in AZ). Native in Afr.; Asia; Australia and cultivated throughout the world. (Latin: *cucumis* = cucumber).

Due to the paucity of materials from Arizona, much of the data in both the generic and species descriptions herein are based on Kirkbride (1993).

1. Fruits prickly ..... ***C. anguria***
1' Fruits reticulate, ridged, scaly, warty, or smooth, not prickly 2
   2. Leaf lobes triangular; corolla tube of staminate flowers 3.5–5(–6) mm long; corolla tube of pistillate flowers 3.5–6.5 mm long ..... ***C. sativus***
   2' Leaf lobes elliptic or oblong to ovate; corolla tube of staminate flowers 0.8–2 mm long; corolla tube of pistillate flowers 1–1.6(–3) mm. long ..... ***C. melo***

Cucumis anguria L. (watermelon) West Indian or Bur Gherkin. —Annual vines. STEMS trailing or climbing, sulcate, hispid. LEAVES with blades deeply palmately 3–5-lobed, ovate to broadly ovate in outline, 30–120(–150) mm long, 25–120(–150) mm wide, the upper surfaces hispidulous. STAMINATE flowers 3–10 per raceme; hypanthium funnelform, 3.5–4 mm long; calyx lobes narrowly triangular 1.5–2.5 mm long; corolla funnelform, the tube 1.5 mm long, the lobes broadly ovate to elliptic, 4–6.5 mm long, 3.5–5.6 mm wide. PISTILLATE flowers solitary, the lower 2/3 of hypanthium fused to ovary, ellipsoid to cylindrical, 7–13 mm long, the upper 1/3 hypanthium free from ovary, 3–5 mm long; calyx lobes narrowly triangular, 1.8–4 mm long; corolla tube, if present, ca. 1 mm long, the lobes obovate to broadly obovate 6–8 mm long, 4–5 mm wide. FRUITS light yellowish green to light yellow, sometimes with light green stripes, usually ellipsoid, 20–70 mm long, 15–40 mm wide, surface prickly

at maturity, the flesh greenish white to yellowish green; seeds elliptic, 5–6 mm long, 2–2.5 mm wide, 1 mm thick. $2n = 24$. (Fig. 7D). —Single collection from a disturbed area in an equipment yard of a pecan orchard likely a spontaneous escape: Cochise Co. (Fig. 4D); 1200 m (3950 ft.); Jul–Oct; introduced in CA, GA, MA, NY; Afr.; Mex.; W. Ind.; C. Amer.; S. Amer.; Marquesas Islands; Australia. Widely cultivated in the New World tropics; possibly of Afr. origin. Young tender fruits are said to be used like cucumbers, raw or prepared as pickles (Dieterle 1976).

Cucumis melo L. (melon) Canteloupe, Honey Dew, Muskmelon. —Annual or perennial vines. STEMS trailing, sulcate, hispid or retrorse strigose. LEAVES with blades broadly ovate in outline, entire or palmately 3–5-lobed, 20–140(–260) mm long, 20–150(–260) mm wide, the surfaces hispid, hispidulous, or pilose, the lobes elliptic or oblong to ovate. STAMINATE flowers in fascicles or panicles of 2–7(–18) flowers; hypanthium campanulate or funnelform, 2.8–4(–5.6) mm long; calyx lobes linear, 1.2–3.6 mm long; corolla funnelform, deeply 5-parted, the tube 0.8–2 mm long, the lobes elliptic, broadly elliptic, or broadly ovate, 2–9(–24) mm long, 2–5(–20) mm wide. PISTILLATE flowers solitary; lower 2/3 of hypanthium fused to the ovary, ellipsoid, 4–11(–14) mm long, the upper 1/3 of hypanthium free from ovary, 2.4–4.5 mm long; calyx lobes linear, triangular, or narrowly elliptic in outline, 1.6–2.8(–8) mm long; corolla tube 0.8–1.6(–2.8) mm long, the lobes broadly obovate, elliptic, or ovate in outline, 3.6–9.2(–20) mm long, 3.2–6.4(–17) mm wide. FRUITS monocolored or bicolored with longitudinal stripes from base to apex, green, red, yellow, white or brown, ellipsoid, globose, cylindrical, ovoid, or obovoid, 20–120+ mm long, 20–50+ mm in diameter, surface reticulate, warty, scaly ridged or smooth, not prickly, the flesh orange to yellowish or green, juicy, sweet; seeds ovate or elliptic, 4–8(–18) mm long, 2.5–4(–13) mm wide, 1–2 mm thick. $2n = 24$. (Fig. 7A). —Possibly naturalized in Sycamore Canyon in Ruby Mts. with riparian woodland in canyon bottom; additional AZ collections in Maricopa and Pima cos. apparently from garden settings: Santa Cruz Co. (Fig. 4D); 1150–1200 m (3800–4000 ft); Jul–Oct; introduced in AL, AK, CA, CT, FL, GA, IL, KY, LA, MA, MI, MS, MO, NV, NH, NM, NY, NC, OH, OK, PA, RI, SC, TX, UT, VA, WV; Can. (Ont.); Asia; Afr.; W. Ind. Widely cultivated all over the world. An Asian origin has been demonstrated for *Cucumis melo* (Sebastian et al. 2010).

Cucumis sativus L. (sown, planted, cultivated) Garden Cucumber. —Annual vines. STEMS trailing or climbing, sulcate, hispid or retrorse-strigose. LEAVES with blades broadly ovate, palmately 5–6-lobed, 60–150(–400) mm long, 60–150(–350) mm wide, hispid on upper surface, the margins serrate, the lobes triangular. STAMINATE flowers (1–)3–7(–10) in fascicles; hypanthium campanulate, 3.5–5(–6) mm long; calyx lobes narrowly oblong to linear, 2.7–4.1(–5.1) mm long; corolla funnelform, the tube 3.4–4.9 mm long, the lobes elliptic, 7–18(–22) mm long, 5–11(–13) mm wide. PISTILLATE flowers usually solitary; lower ¾ of hypanthium fused to the ovary, ellipsoid or ovoid, 9.5 –10.5 mm long, upper ¼ of hypanthium free from ovary, 3.2–3.6 mm long; calyx lobes narrowly elliptic, 2.8–3.6(–12) mm long; corolla tube 3.5–6.5 mm long, the lobes broadly elliptic 10–15(–25) mm long, 9.5–15(–18) mm wide. FRUITS green, white, yellow, or brown, monocolored or with light green to whitish

stripes, elliptic to cylindric, 50–200(–250) mm long, 30–50(–120) mm wide, smooth, the flesh whitish; seeds elliptic to ovate, 7.2–11.2 mm long, 3.2–4.9 mm wide, 1.3–1.6 mm thick. $2n = 14$. (Fig. 7C). —Rare spontaneous escape from cultivation in relatively moist areas with *Populus fremontii*, *Lycium*, *Suaeda*, *Prosopis*, *Parkinsonia*, *Atriplex*, *Solanum*: Maricopa Co. (Fig. 4D); ca. 300 m (950–1000 ft.); Aug–Nov; introduced in AR, FL, GA, HI, IL, KS, KY, LA, MA, MI, MS, MO, NY, NC, OW, PA, SC, UT, VA; Ontario, Can.; Asia; W. Ind.. Cultivated worldwide. An Asian origin has been demonstrated for *Cucumis sativus* (Sebastian et al. 2010).

Cucurbita L. Gourd, Squash

Annual or perennial vines (or compact tufted herbs with reduced tendrils in some cultivars) from taproot or fibrous or tuberous roots, monoecious. STEMS trailing or climbing, angled, sulcate. TENDRILS simple or 2–7-branched. LEAVES with blades suborbicular to broadly ovate, ovate-lanceolate, reniform, or triangular, lobed or unlobed, commonly pilose or scabrous, muriculate in ours. STAMINATE flowers solitary, 5-merous; hypanthium campanulate; calyx lobes linear; corolla yellow, prominently veined and ribbed, campanulate, connate ca. ½ its length into a tube, the lobes apiculate; stamens 3, the filaments separate, the anthers linear, connivent to form a cylindrical twisted column. PISTILLATE flowers solitary; perianth like that of staminate flowers; ovary ellipsoid, ovoid, or globose, the ovules numerous; style 1, short-columnar, the stigmas 3, each 2-lobed. FRUITS pepos, fleshy or fibrous; seeds white or light beige in ours, numerous, ovate or ovate-oblong, strongly compressed, smooth, with or without a differentiated margin. —14–22 spp. (6 in AZ) in warm Amer., 5 of which are widely cultivated. Three cultivated species, *Cucurbita maxima*, *C. moschata*, and *C. pepo*, are included here on the basis of single collections that likely represent spontaneous escapes, not naturalized occurrences. Much of the data in these species descriptions are based on Nesom (2015) and McVaugh (2001). (Latin: *cucurbita* = gourd).

1. Plants perennial; roots tuberous; plants native.....2
   2. Leaf blades longer than wide, unlobed or shallowly lobed at base; tendrils branched at apex of tendril stalk ..... ***C. foetidissima***
   2' Leaf blades not longer than wide, distinctly palmately lobed; tendrils branched near base, without tendril stalk 3
      3. Leaves lobed nearly to base of blade, the lobes linear-lanceolate, the central lobe usually at least 5 times longer than wide ..... ***C. digitata***
      3' Leaves not lobed to base of blade, the lobes triangular or lanceolate, the central lobe usually less than 3.3 times longer than wide..... ***C. palmata***
1' Plants annual; roots not tuberous; plants cultivated, rarely spontaneous escapes ...4
   4. Stems hirsute with pustulate-based hairs ..... ***C. pepo***
   4' Stems pilose to hirsute without pustulate-based hairs 5
      5. Peduncles in fruit relatively soft, corky-thickened, terete, neither prominently ribbed nor abruptly expanded at point of fruit attachment.....***C. maxima***

5' Peduncles in fruit hardened, woody, 5-ribbed, abruptly expanded at point of fruit attachment ..... ***C. moschata***

Cucurbita digitata A. Gray (finger, in reference to the narrowly lobed leaves) Finger-leaved Gourd. —Perennial vines from large tuberous roots. STEMS trailing or climbing, relatively slender, 1–3 mm in diameter, sparsely strigose with hairs 0.5–1 mm long or glabrate. TENDRILS slender, 3–4-branched near axil, the branches loose or coiled into heads along stem. LEAVES with blades grayish-dark-green (midribs usually distinctly lighter in color), about as long as wide, pedate, the 3 main lobes extending to base of blade, the 2 lateral lobes divided again nearly to base, the lobes linear-lanceolate, the central lobe 70–145 mm long, 11–20 mm wide; upper surfaces strigose, with scattered hairs 0.5 mm long, densely and prominently strigose along veins; lower surfaces scabrous with stiff spreading and appressed pustulate-based hairs 0.2–1 mm long. STAMINATE flowers with hypanthium ca. 33 mm long; calyx lobes 6–8 mm long; corolla tube 20–22 mm long, the lobes 18–20 mm long. PISTILLATE flowers with hypanthium 12–16 mm long; calyx lobes 3–5 mm long; corolla tube ca. 20 mm long, the lobes 20–25 mm long. PEDUNCLES in fruit shallowly 5-ribbed, not abruptly expanded at point of fruit attachment, spongy. FRUITS pale yellow at maturity, globose to depressed-globose, 750–850 mm across, the rind thin, hard shelled, with 10 narrow and well-defined longitudinal stripes; seeds white, 10–11 mm long, 6–7 mm wide, without a differentiated margin, the surface smooth. $2n = 40$. (Fig. 6). —Along roadsides and in sandy alluvium of valleys and washes: Cochise, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pima, Pinal, Santa Cruz, Yavapai, Yuma cos. (Fig. 2A); 1650 m (5000 ft) or lower; Jul–Nov; s CA, NM, w TX; Mex. (n Son., Baja C. Norte). Natural hybridization between *Cucurbita digitata* and *C. palmata* has been reported south of Quartzite near the La Paz/Yuma Co. line (Fig. 2D) (Bemis and Whitaker, 1965).

Cucurbita foetidissima Kunth (very foul) Buffalo Gourd, Calabazilla. — Perennial vines, strong-smelling, from large tuberous roots. STEMS coarse, trailing, 3–5 mm in diameter, sulcate, prominently muriculate with stout, stiff, spreading or curved pustulate-based hairs to 0.5 mm long and variously pubescent with curved and appressed hairs 0.2–0.3 mm long. TENDRILS stout, 3–7-branched, mostly coiled into a head at apex of stalk 40–60 mm long. LEAVES with blades coarse and thick, gray-green, triangular-ovate, (85–)145–220(–250) mm long, 75–155(–170) mm wide, unlobed or occasionally shallowly lobed at base, the base cordate to nearly truncate, the apex usually acute and mucronate, the margins dentate, prominently veined, the upper surfaces scabrous with hirsute to strigose hairs 0.3–0.5 mm long, the lower surfaces similar but often grayer, more densely scabrous, the veins muriculate. STAMINATE flowers with hypanthium 10–20 mm long; calyx lobes 8–18 mm long; corolla with spreading or curved hairs to 1.3 mm long, muriculate along veins, the tube 32–45 mm long, the lobes 36–48 mm long, apiculate. PISTILLATE flowers with hypanthium 16–30 mm long; calyx lobes 9–11 mm long; corolla similar to that of staminate flowers, the tube 48–90 mm long, the lobes 30–50 mm long, apiculate. PEDUNCLES in fruit 5-ribbed, slightly expanded or not at point of fruit attachment, hardened, woody. FRUITS yellow at maturity with 5–6 main cream-white longitudinal

stripes, globose to depressed-globose, 50–100 mm across, the rind thin, hard-shelled; seeds white, 9 mm long, 4.5–5 mm wide, without a differentiated margin, surface smooth. $2n = 40, 42$. (Fig. 5D, 10F). —In disturbed sandy or gravelly alluvial sites along streams, roadsides or in fallow fields: Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai cos. (Fig. 2B); 350–2350 m (1000–7000 ft); May–Aug; WY, NE, MO, KS to CO, UT, NV, TX, NM, CA; Mex. Indigenous cultures of Arizona ate the cooked fruit and the seed in the form of a mush. The species has the potential of becoming a cultivated food crop because the seeds are rich in oil and protein and the large storage roots contain abundant starch resources (DeVeaux and Shultz 1985, Bemis et al. 1978).

Cucurbita maxima Duchesne (greatest, in reference to the immense fruits of certain cultivars) Hubbard Squash. —Annual vines or herbs from fibrous roots. STEMS climbing, or compact and tufted in some forms, striate, short pilose to villous or hirsute-villous without pustulate-based hairs. TENDRILS 2–5-branched. LEAVES with blades green, occasionally with white blotches, orbicular to reniform, unlobed to shallowly 5–7-lobed, 150–300 mm long, 200–360 mm wide, hispid-aculeate primarily on veins, without pustulate-based hairs. FLOWERS with hypanthium 20–25 mm long; calyx lobes 5–20 mm long; corolla 50–70(–80) mm long. PEDUNCLES in fruit cylindric, smooth, not ribbed, not expanded at point of attachment, spongy. FRUITS yellow, red, orange, or green, variously globose, obovoid, oblong cylindric, or flattened cylindric, 100–400 mm long, smooth, the flesh yellow to orange, not bitter; seeds white, whitish-gray, or pale brown, suborbiculate to broadly elliptic or obovate, 12–22 mm long, the margin raised-thickened or not, the surface smooth or slightly rough. $2n = 40$. (Fig. 9C). —Single collection from roadside in Apache Co. likely a spontaneous escape (Fig. 4A). Introduced in AR, GA, ME, MA, MI, NY, NC, OH, PA, SC, UT, VT, VA, WI; W. Ind.; S. Amer.; Eur. (Denmark, England, Germany, Hungary, Spain); New Zealand; Australia. Widely cultivated; cultivars include: Winter, Hubbard, Blue Hubbard, Golden Hubbard, Turk's Turban, Banana, Queensland Blue, Buttercup, Winter Marrow, Atlantic Giant, and Mammoth Pumpkin. *Cucurbita maxima* reportedly arose from the wild *C. andreana* Naudin of S. Amer. (Sanjur et al. 2002).

Cucurbita moschata Duchesne (perfumed with musk) Butternut Squash. —Annual vines or herbs from taproot or fibrous roots. STEMS climbing or compact and tufted in some forms, villous-hirsute, without pustulate-based hairs. TENDRILS 3–5-branched 15–80 mm above base or reduced in tufted forms. LEAVES ovate to suborbicular or reniform, often shallowly 3–5-lobed, wider than long, 50–250 mm long, (80–)100–250(–300) mm wide, the upper surfaces densely villous-hirsute without pustulate-based hairs, the lower surfaces less densely hairy. STAMINATE flowers campanulate; hypanthium 3–10 mm long; calyx lobes 10–40 mm long; corolla 50–123(–135) mm long, the tube 18–72 mm long, the lobes 35–54 mm long. PISTILLATE flowers like that of staminate flowers; calyx lobes up to 75 mm long. PEDUNCLES in fruit 5-ribbed, widely expanded at point of fruit attachment, hardened, woody. FRUITS green, cream-speckled to evenly brown, or wholly white, globose or depressed globose to ovoid conic, cylindric, pyriform, or lageniform, 100–400(–1200) mm long, smooth or with rounded ribs, the flesh yellow to orange, lightly to very sweet; seeds whitish to

cream or light brown, ovate elliptic to elliptic or obovate, 8–21 mm long, the margin golden yellow to silvery, raised-thickened, the surface punctate-sculptured. $2n = 40$. (Fig. 9B) —Single collection from Apache Co. likely a spontaneous escape (Fig. 4D). Introduced in FL, GA, KY, LA, MS, NC, PA, SC, TN, TX, VA; w S. Amer.; Mex.; W. Ind.; C. Amer.; Galapagos Islands; elsewhere in S. Amer. in French Guiana, Guyana, and Surinam. Widely cultivated; cultivars include: Butternut, Tahitian Squash, Golden Cushaw, Calabaza, Neck or West Indian or Seminole or Large Cheese, Long Island Cheese, Kentucky Field, Dickinson Pumpkin, and Tennessee Sweet Potato. Recent studies suggest that cultivation of *Cucurbita moschata* originated in the lowlands of northern S. Amer. (Sanjur et al. 2002).

Cucurbita palmata S. Watson (hand, in reference to the 5-lobed leaves that resemble a human hand) Coyote Melon. —Perennial vines from long, fusiform tubers deep underground. STEMS trailing, 1–2.5 mm in diameter, angled and sulcate, strigose, the hairs 0.25–1 mm long, often muriculate. TENDRILS 3–4-branched near axil, the branches loose or coiled into heads along stem. LEAVES with blades grayish green (primary veins distinctly lighter in color) about as wide as long, 5-lobed, the upper surfaces with strigose hairs 0.25–0.75 mm long, densely and prominently strigose along veins, the lower surfaces scabrous with stiff spreading and appressed hairs 0.2–0.8 mm long, many hairs pustulate-based, the lobes lanceolate, not extending to base of blade, the central lobe 30–100 mm long, 12–39 mm wide at base. STAMINATE flowers with hypanthium 21–22 mm long; calyx lobes 4–8 mm long; corolla tube 18–19 mm long, the lobes 5, short woolly-pilose, 12–14 mm long, apiculate. PISTILLATE flowers with hypanthium 17–25 mm long; calyx lobes 4–6 mm long; corolla tube 35–36 mm long, the lobes short woolly-pilose, 10–25 mm long, apiculate. PEDUNCLES in fruit shallowly 5-ribbed, not abruptly expanded at point of fruit attachment, spongy. FRUITS pale yellow to beige at maturity, globose or depressed-globose, 75–85 mm in diameter, 75–87 mm high, the rind thin, hard-shelled, with 10 longitudinal stripes; seeds white to light beige, ovate to oblong, 11–12 mm long, 7.5–8 mm wide, without a differentiated margin, the surface smooth or slightly rough. $2n = 40, 42$. (Fig. 5B, 10E). —Along roadsides and in sandy alluvium of valleys and streams: Coconino, La Paz, Mohave, Maricopa, Yavapai, Yuma cos. (Fig. 2C); 1050 m (3200 ft) or lower; May–Nov; s CA, NV; Mex. (Baja C. Norte).

Cucurbita pepo L. (melon, in reference to the fleshy berry-like fruit with a rind and spongy seedy interior) Pumpkin. —Annual vines or herbs from taproot or fibrous roots. STEMS trailing or climbing or compact and tufted in some forms, hispid with persistent, strongly pustulate-based hairs. TENDRILS 2–7-branched 10–50 mm above base or reduced in tufted forms. LEAVES broadly ovate-cordate to triangular-cordate or reniform, shallowly to deeply palmately (3–)5–7-lobed, 200–300 mm long, 200–350 mm wide, usually wider than long, the surfaces hirsute, hirsute-strigillose, villous-strigose, or hispidulous-scabrous. STAMINATE flowers with hypanthium 9–10 mm long; calyx lobes 8–12 mm long; corolla 82–97 mm long, including lobes 39–52 mm long, apiculate. PISTILLATE flowers similar staminate flowers; hypanthium 34–61 mm long, fused to the ovary for most of its length; calyx lobes 7–21 mm long; corolla 50–97 mm long, including lobes 20–55 mm long, apiculate. PEDUNCLES in fruit

strongly angled, 5-ribbed, not or very gradually expanded at point of fruit attachment, hardened, woody. FRUITS green, green with white stripes, yellow, or orange, globose, depressed globose to ovoid, obovoid, ellipsoid ovoid, pyriform, cylindric, 50–100(–250) mm long, smooth or with rounded ribs, the flesh whitish to yellowish or pale orange, not bitter; seeds white to cream or tawny, elliptic to obovate, 7–15(–26) mm long, the margin raised-thickened, the surface smooth. $2n = 40$. (Fig. 9A). —Single collection from a side canyon west of Chilchinbito in Navajo Co. likely a spontaneous escape from cultivation (Fig. 4C); introduced in AL, CA, CT, KS, KY, LA, MA, MI, NV, NH, NM, NY, OH, PA, SC, TN, UT, VA; Mex.; S. Amer.; W. Ind.; C. Amer.; Eurasia; and Atlantic Islands. Widely cultivated; cultivars include: Field or Jack-o-lantern Pumpkin, Cocozelle, Vegetable Marrow, Zucchini, and Citrouille. The wild ancestor of *Cucurbita pepo* is unknown and possibly extinct. Domestication of *Cucurbita pepo* probably occurred in southern Mexico, the site of the oldest *C. pepo* remains (Smith 1997).

Cyclanthera Schrad. Bur Cucumber

Annual or weak perennial vines from fibrous roots, monoecious. STEMS climbing, sulcate, glabrous or pubescent. TENDRILS simple to unequally 3-branched. LEAVES lanceolate to orbicular, nearly entire to 3–9 lobed to pedately 3–5-foliolate, glabrous or pubescent. STAMINATE flowers in few to many flowered axillary racemes or panicles; hypanthium cupulate or salverform; calyx lobes vestigial in ours; corolla white, rotate, the tube <1 mm long, the lobes 5, oblong-ovate to triangular, 1–5 mm long; stamen filaments united into a central column, the anthers connate into a horizontal orbicular head, dehiscing in a ring around anther head. PISTILLATE flowers usually solitary, in same axil with staminate inflorescence; perianth similar to that of staminate flowers but usually larger; ovary obliquely ovoid, rostrate, the style 1, sessile or stalked, the stigma 1, hemispherical. FRUITS capsules, oblique-ovoid, somewhat fleshy, usually echinate, explosively dehiscent the entire length in ours, with few to many seeds; seeds usually turtle-shaped, somewhat flattened. —Ca. 35 spp. (1 in AZ), CO, KS, NM, OK, TX; Mex.; C. Amer.; S. Amer. (Greek: *cyclos* = circle + *anthera* = anther).

Cyclanthera gracillima Cogn. (slender, thin) Slender Cyclanthera. —Annual vines. STEMS slender, 0.6–1.5 mm in diameter, the internodes glabrous, the nodes sparsely pubescent with spreading flexuose hairs. TENDRILS unbranched or 2-branched. LEAVES with blades broadly ovate to circular, pedately trifoliolate, the upper surfaces scabrous with crystalline, papillate, protuberances and short hirsute to strigose hairs along primary veins, the hairs more dense at juncture of leaflets, the lower surfaces essentially glabrous, the central leaflet 10–50 mm long, 3–23 mm wide, the lateral leaflets usually deeply bisected. STAMINATE flowers in racemes or panicles with most flowers in upper 5–10 mm of inflorescence; hypanthium 0.8–1 mm long; corolla lobes triangular, 1.2–2.5 mm long, smooth to minutely papillate on both surfaces; filament column 0.2–0.5 mm long, the anther head 0.6–1.1 mm in diameter. PISTILLATE perianths similar to staminate flowers; ovary 5.5–13 mm long, including beak, the style to 0.2 mm long, the stigma 1.1 mm wide. FRUITS 16–23 mm long,

glabrous, prominently echinate with smooth prickles 2.5–5 mm long; seeds dark brown to black, with bases rounded to truncate, the apex narrowed, the margin often toothed, the surface variously sculpted, 5–7 mm long, 4–5.5 mm wide, 1–1.5 mm thick. (Fig. 10C). —Along canyons and streams: Pima Co. (Fig. 1C); 1350 m (4000 ft); Sep–Oct; AZ, CO, KS, NM, OK, TX; Mex. *Cyclanthera* in Arizona was treated by Kearney et al. (1960) as *C. dissecta* (Torr. & A. Gray) Arn. Nesom (2014) treated *C. dissecta* as endemic to the southeastern Texas coastal plain.

Echinocystis Torr. & A. Gray Wild Mock-Cucumber

Annual vines from taproot or fibrous roots, monoecious. STEMS climbing, sulcate, 1.2–3 mm in diameter, glabrous to sparsely pubescent with flexuose hairs to 1 mm long. TENDRILS 3-branched. LEAVES with blades suborbicular to ovate in outline, to 150 mm long and wide, deeply 5-lobed, the lobes triangular to ovate, the margins subentire to denticulate to serrulate, the upper surfaces scabrous with tuberculate strigose hairs, the lower surfaces sparsely scabrous. STAMINATE flowers in narrow, many-flowered panicles, 25–315 mm long, the peduncle and pedicels with soft, flexuose hairs to 0.5 mm long; hypanthium white, broadly campanulate, 1–2 mm long, 2–3 mm wide; calyx 6-lobed, the lobes linear, 1–2 mm long; corolla white, rotate, connate ¼ length into a tube, 6-lobed, the lobes erect or spreading, lanceolate, to 7 mm long, 0.7–1.5 mm wide at base, the upper surface with stipitate glandular hairs; stamens united into cylindrical anther head 0.7–1 mm long, 0.5–0.8 mm in diameter. PISTILLATE flowers usually solitary in axil of staminate inflorescence or at base of lowest branch of staminate panicle; perianth similar to that of staminate flowers; hypanthium 1–1.5 mm long; calyx lobes 2–3.2 mm long; corolla lobes 6.5–12 mm long, 1.1–1.8 mm wide at base; ovary 2-celled, the style 1, nearly vestigial, the stigmas 3, subglobose to 1 mm wide. FRUITS capsules, ovoid, 35–50 mm long, 20–37 mm wide, bladdery-inflated, glabrous with slender glabrous prickles 2–11 mm long, dehiscing irregularly at apex; seeds brown with irregular beige sculpturing, broadly oblong-ellipsoid, flattened, obtuse at apex, narrowed at base, 16–18 mm long, 8–9 mm wide, 3 mm thick. $2n = 32$. —Monospecific genus. (Greek: *echinos* = spiny + *kystis* = bladder, in reference to the prickly, bladdery-inflated fruit).

The description above has been augmented with data from Stocking (1955a).

Echinocystis lobata (Mich.) Torr. & A. Gray (in reference to the lobed leaves) (Fig. 5C). —In alluvial soil along streams and canyon floors, climbing over shrubs and trees: Coconino Co. (Fig. 3A); 1700 m (5200 ft); May–Sep; primarily in s Can. and U.S. e of Rocky Mountains and n of Ohio River, apparently escaped from cultivation and sporadic in w U.S.

Echinopepon Naud. Wild Balsam Apple

Annual vines from taproot or fibrous roots, monoecious. STEMS climbing or trailing, mostly slender, sulcate, glabrous or variously pubescent. TENDRILS 2–3-branched. LEAVES with blades reniform to orbiculate, the margins entire to denticulate to ± deeply 3–5(–7)-lobed, the surfaces hispid to hispidulous.

STAMINATE flowers in racemes or narrow panicles, pedicels persistent; hypanthium campanulate; sepals small or minute; corolla white, campanulate or rotate; anthers 5, almost fused or fused into a globose or discoid head, the filaments fused. PISTILLATE flowers solitary or in 2's or 3's, from same node as staminate inflorescences; hypanthium beyond the beaked ovary campanulate; corolla similar to but larger than those of staminate flowers; ovary 2-celled, the style 1, the stigma 1, subglobose. FRUITS capsules, ovoid or ellipsoidal, beak slender and tapering to a point, glabrous or hairy, conspicuously echinate, operculate; seeds 2–5 per carpel, quadrangular or angular-ovate, flattened, more or less rugose. —19 spp. (1 in AZ) in sw U.S.; Mex.; C. Amer.; S. Amer. (Greek: *echinos* = spiny + *pepon* = melon, in reference to the prickly fruit)

The description above is augmented with data from Stocking (1955a) and Monro and Stafford (1998).

Echinopepon wrightii (A. Gray) S. Watson. (for Charles Wright, 1811–1885, botanist on several surveys of the Mexican boundary region, 1847–1852). —STEMS 0.5–2 mm wide, densely pilose with glandular and eglandular hairs. LEAVES with blades 20–100 mm long, 25–80(–150) mm wide, the apex acuminate, the margins subentire to undulate to shallowly 3–5-lobed, both surfaces hirsute and glandular-pilose primarily along veins and margins. STAMINATE flowers in 13–37 flowered racemes 50–150 mm long; pedicels densely pilose with glandular and eglandular hairs, 1–17 mm long; hypanthium 0.75–1.5 mm long; calyx lobes linear-lanceolate, 0.25–0.5 mm long; corolla rotate, the tube 0.5–1.0 mm long, the lobes triangular to ovate, 1.75–4 mm long, 1.25–1.5 mm wide at base, with margins and upper surfaces conspicuously glandular; anther head 0.5–1 mm wide, the column of filaments 0.75 mm long. PISTILLATE flowers with pedicels 3–15 mm long, pilose with glandular and eglandular hairs; hypanthium beyond the ovary 1–1.5 mm long; corolla tube 0.5–1 mm long, the lobes 2–4 mm long, 1.5–2 mm wide at base; ovary, obovoid, the prickles and beak pilose with glandular and eglandular hairs. FRUITS capsules, obovoid, 20–39 mm long, the beak 9–11 mm long, stipitate glandular, the prickles to 2 cm long; seeds light brown, 6–7 mm long, 3.5–5 mm wide, 1–2 mm thick, compressed, quadrangular above narrowed base. $2n = 24$. (Fig. 10K, L). —Along streams and canyon floors, climbing over shrubs and small trees: Cochise, Gila, Graham, Maricopa, Pima, Pinal, Santa Cruz, Yavapai cos. (Fig. 1D); 1000–2650 m (3000–8000 ft); Jul–Oct; NM; Mex. (Son.).

Ibervillea Greene Globe-berry

Perennial vines from thickened (napiform) or branched tuberous roots, dioecious. STEMS climbing, terete or sulcate, strigose, tomentose, or glabrous. TENDRILS simple. LEAVES with blades reniform to broadly ovate in outline, shallowly to deeply 3–5-lobed to pedate, glabrous, tomentose, or variously hispid, the lobes often lobulate or coarsely toothed. STAMINATE flowers in axillary racemes or fascicles; hypanthium narrowly campanulate or tubular; calyx lobes 5; corolla yellow or greenish-yellow, salverform, the lobes with bifid apices, the margins undulate; stamens 3, free, inserted near hypanthium rim. PISTILLATE flowers solitary, similar to that of staminate flowers; ovary fusiform, the style 1, the stigmas 3. FRUITS yellow,

orange, or red at maturity, the berries, globose, ovoid, or ellipsoid, smooth; seeds arillate, ovoid or pyriform, narrowed at base, tumid, the lateral faces smooth or corky-pleated, the margin prominent, raised. —Ca. 5 spp. (1 in AZ); sw U.S.; Mex. (Possibly named for Pierre LeMoyne Sieur D'Iberville, a 17th century explorer and settler in America).

The description is augmented with data from Kearns (1994a).

Ibervillea tenuisecta (A. Gray) Small (cut thin, in reference to the narrowly dissected leaves). —STEMS slender, 0.5–1 mm in diameter, sulcate, glabrous. LEAVES with blades to 47 mm long, deeply 3-lobed or pedate, usually narrowly so, the upper surfaces glabrous, the lower surfaces sparsely strigose often from conspicuous cystolithic bases, the lobes lobulate and coarsely toothed. STAMINATE flowers in racemes 4–17 mm long; hypanthium 4–6 mm long; calyx lobes 1–1.5 mm long; corolla lobes puberulent, 2–4 mm long. PISTILLATE flowers on pedicels 10–33 mm long; hypanthium tubular-campanulate, 8–12 mm long, prolonged 4–8 mm beyond the ovary; calyx lobes 1–2 mm long; corolla lobes to 3.5 mm long. FRUITS bright-red when mature, globose, 11–20 mm in diameter; seeds brown or brownish black, ovoid, 5.5–6 mm long, 3.5–4.5 mm wide, 2.8 mm thick, rounded at tip. [*Maximowiczia lindheimeri* Cogn. var. *tenuisecta* (A. Gray) Cogn., *Ibervillea lindheimeri* (A. Gray) Greene var. *tenuisecta* (A. Gray) M. C. Johnston]. (Fig. 10G, H). —On rocky, limestone hillsides and on alluvium along tributaries with *Larrea divaricata*: Cochise, Pima cos. (Fig. 4A); 1150–1350 m (3500–4000 ft); Aug–Oct; s NM, w TX; n Mex.

It is unknown whether two collections (*Shreve 6386* and *Parker s.n.*, ARIZ) of *I. tenuisecta* from Tumamoc Hill in Pima Co., the type locality of *Tumamoca macdougalii*, represent natural occurrences or transplants. The species is known elsewhere in Arizona from southeastern Cochise Co. more than 100 miles distant.

Lagenaria Ser. Bottle Gourd

Annual vines from taproot, monoecious. STEMS climbing or trailing, densely villous to puberulent. TENDRILS 2-branched. LEAVES with a pair of large marginal annular glands near the bases of the primary lateral veins; blades broadly reniform or ovate, palmately 3–5(–7)-lobed, the surfaces puberulous or pubescent, the lobes triangular to widely obovate. STAMINATE flowers solitary, axillary; hypanthium white to cream, campanulate to funnelform; calyx lobes 5, subulate to triangular or linear; corolla lobes white to cream, 5, obovate to oblong-obovate, (15–)20–25(–45) mm long, puberulent or glabrous; stamens 3, the filaments inserted in hypanthium tube, distinct, the thecae connate, forming a head, usually much contorted. PISTILLATE flowers solitary, in same axils as staminate; perianth similar to that of staminate flowers; ovary subglobose to ellipsoid, ovoid or cylindric, the style 1, short columnar, the stigmas 3, each 2-lobed. FRUITS pepos, green to greenish yellow maturing yellowish or pale brown, commonly mottled or with light green to white longitudinal stripes, subglobose to cylindric, ellipsoid or flask-shaped, usually smooth, woody at maturity; seeds oblong to ovoid-oblong, compressed, with marginal groove, the surface smooth. —6 spp. (1 in AZ); introduced widely. (Greek: *lagenos* = flask, alluding to shape and use of fruit).

Due to the paucity of materials from Arizona, much of the data in both the generic and species descriptions herein are based on McVaugh (2001) and Nesom (2015).

Lagenaria siceraria (Molina) Standl. (a spirituous or fermented liquor) Bottle Gourd. —STEMS 1–7 m long, rooting at nodes. LEAVES with blades 30–250(–400) mm long, 40–250(–400) mm wide. STAMINATE flowers with hypanthium 13–18 mm long; calyx lobes 5–9 mm long; corolla lobes 35–47 mm long, spreading, broadly obovate, strongly green-veined on the outer surface; margins often ruffled. PISTILLATE flowers with perianth similar to that of staminate flowers but smaller; corolla lobes 20–25 mm long. FRUITS terete, smooth, very variable in size and shape, 100–500 mm long. $2n = 22$. (Fig. 8A). —Included here based on a single collection from a dump area, presumably an escape from plantings in the adjacent Desert Botanical Garden in Phoenix: Maricopa Co. (Fig. 4B); introduced in AK, AR, FL, GA, IL, KY, LA, MA, MS, MO, NY, NC, OK, PA, SC, TX, VA; Asia; Afr.; W. Ind.; S. Amer.; Eur.; Australia. DNA analysis of archeological rind fragments from North American bottle gourds indicate an Asian source of the early introduction to the New World (Clark 2006, Erikson 2005).

Marah Kellogg Big-Root, Wild Cucumber

Perennial vines from large tuberous roots, monoecious. STEMS climbing or trailing, annual, sulcate, glabrous to sparsely hirsute. TENDRILS slender, simple to 3-branched. LEAVES with blades broadly ovate to suborbicular, variously palmately 5–7-lobed, the surfaces subglabrous or pubescent. STAMINATE flowers in a raceme or narrow panicle; hypanthium shallowly campanulate to cupulate; calyx lobes diminutive; corolla white, cream-yellow, greenish yellow, or greenish, campanulate or rotate, the margins and upper surfaces glandular-punctate; anthers normally 3, folded, fused into a globose head with a short column of united filaments. PISTILLATE flowers solitary, in same axils as staminate flowers; perianth similar to but often larger than staminate flowers; style 1; stigma 1, discoid to subglobose. FRUITS capsules, ovoid to globose, beaked, densely to sparsely echinate, dehiscing irregularly at or near the apex; seeds grey, brown, or olive, large, globose or somewhat flattened, smooth, the margin usually not differentiated, slightly grooved in several species. —7 spp. (1 in AZ) in w U.S.; Mex. (Latin: *amarus* = bitter).

The description is augmented with data from Stocking (1955b).

Marah gilensis (Greene) Greene (of the Gila River). —LEAVES with blades 40–84 mm wide, deeply lobed, the upper surfaces scabrous with minute protuberances or short strigose hairs from disk-like or bulbous bases, the lower surfaces sparsely hirsute or strigose along primary veins and margins. STAMINATE inflorescence to 250 mm long; hypanthium <1mm long; corollas white, rotate, 6–10 mm wide, the lobes triangular to lanceolate, 3–3.5 mm long. PISTILLATE hypanthium 5–10 mm long; corollas white, rotate, 8–12 mm wide, the lobes 2–4 mm long; carpels and ovules usually 4. FRUITS globose, 25–35 mm wide; seeds brown, 4, somewhat flattened, ovoid, 12–14 mm long, encircled with a grooved ridge. $2n = 30$. (Fig. 10O). —Among

shrubs and rocks of canyons and streams: Cochise, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pima, Pinal, Santa Cruz, Yavapai cos. (Fig. 3B); below 1500 m (4500 ft); Feb–May; sw NM, s NV. Tuberous roots of *Marah fabaceus* (Naud.) Greene are used in a laxative called Stroughton's Bitters; tuberous roots and seeds of *Marah* are potential sources of starch and oil, respectively (Stocking 1955b).

Sicyos L. One-Seeded Bur-Cucumber

Annual vines from fibrous roots, monoecious. STEMS climbing or trailing, glabrous or pubescent, with or without glands. TENDRILS 2–5-branched. LEAVES with blades ovate, orbiculate, or reniform, 3–7-angled to palmately 3–9-lobed, the surfaces glabrous or pubescent. STAMINATE flowers numerous in racemes or panicles; hypanthium shallowly cup shaped or subrotate; calyx lobes 5, diminutive; corolla white, cream, yellowish or green, campanulate to cupulate; stamens 3, united, the filaments connate into a column, the anthers curved or flexuous, more or less coherent and twisted in a head. PISTILLATE flowers capitate on a common peduncle; perianth similar to that of staminate flowers, usually smaller; ovary ovoid to fusiform, the ovule 1, the style 1, the stigma 1, capitate or 2–3-lobed. FRUITS clustered on a common peduncle, ovoid, 1-seeded, sometimes attenuate into a beak, angled, ribbed, glabrous, spiny, bristly, or variously pubescent, indehiscent; seeds solitary, smooth, shiny, without a differentiated margin. —Ca. 50 spp. (1 in AZ); N. Amer.; C. Amer.; S. Amer.; sw Pacific; Australia; New Zealand; introduced in Eur., Asia. (Greek: *sicyos* = cucumber)

Sicyos laciniatus L. (refers to the deeply lobed leaves, a common morphology in populations in the southern part of the range of the species in Mex.) Cut-leaf Bur Cucumber. —STEMS climbing, slender 1–1.8 mm in diameter, sulcate, scabrate with stiff spreading to appressed hairs 0.1–0.7 mm long. TENDRILS 3–4-branched. LEAVES with blades triangular to ovate, shallowly 3-lobed; margins dentate; apices attenuate; both leaf surfaces scabrous with spreading and appressed hairs 0.1–0.5 mm long; hairs often from prominent white crystalline bases; central lobe 50–55 mm long; lateral lobes 55–70 mm wide, sometimes again shallowly 2-lobed. STAMINATE flowers in racemes 7–15 mm long; hypanthium shallowly campanulate, 1 mm long; calyx lobes 0.2–0.5 mm long; corolla lobes 1.0–2.5 mm long, 1.2–2 mm wide at base, white; stamens united, the filaments forming a central column with the anthers sessile at its apex. PISTILLATE flowers usually from same leaf axil as the staminate flowers, 4–6, sessile at apex of peduncle 4.5–6 mm long; hypanthium 1 mm long; calyx lobes diminutive; corolla lobes 1 mm long, 0.6–0.8 mm wide at base, white; stigma 2-lobed. FRUITS dry, ovoid to ellipsoid, 5–6 mm long, conspicuously setose, setae stramineous, retrorsely barbed, 2–3 mm long. [*S. laciniatus* L. var. *subinteger* Cogn., *S. ampelophyllus* Woot. & Standl.]. (Fig. 10J). —In shaded areas on rocky slopes and along streams: Apache, Cochise, Greenlee, Navajo, Pima, Yavapai cos. (Fig. 3C); 1200–2400 m (3900–7900 ft); Aug–Oct.; NM, w TX; Mex.

Sicyos in Arizona was treated by Kearney et al. (1960) as including *S. laciniatus* and *S. ampelophyllus* Woot. & Standl. Nesom (2011) treated *S. ampelophyllus* as a synonym of *S. laciniatus*.

Sicyosperma A. Gray Climbing Arrowheads

Annual vines from fibrous roots, monoecious. STEMS climbing, slender, 0.5–1.2 mm in diameter, sulcate, glabrous or variously pubescent with prominent, spreading hairs 0.3–0.9 mm long and more delicate appressed hairs 0.1–0.5 mm long. TENDRILS 2-branched. LEAVES petiolate or occasionally sessile; blades triangular to ovate to orbicular, 11–80 mm long, 15–102 mm wide, usually 3-lobed, the margins crenate to serrate, the upper surfaces and margins scabrous with strigose hairs 0.1–0.4 mm long from white crystalline bases, the lower surfaces sparsely strigose, primarily along veins. STAMINATE flowers 14–19 in racemes or panicles to 15 mm long; hypanthium rotate to openly campanulate, 0.5 mm long; calyx lobes diminutive 0.2–0.3 mm long; corolla white, the lobes lanceolate, 0.5–1.2 mm long, 0.6–0.7 mm wide at base, apically bifid with linear lobes 0.3–0.8 mm long; anthers united in cylindric head 0.2 mm wide, 0.2–0.3 mm long, the column of united filaments 0.2–0.4 mm long. PISTILLATE flowers often in same axils as staminate flowers, solitary or in bracteate racemes of 3–6 flowers, the flowers subtended and loosely enveloped in sessile, deltate bracts with crenate to dentate-serrate margins; perianth like that of staminate flowers; ovary 1-locular, ovoid, with 1 ovule; style 1; stigma 1, capitate, 3-lobed. FRUITS brown with whitish exocarp, glabrous, smooth, dry, 1-seeded, 4 mm long, 2.9 mm wide, 2 mm thick, narrowed at both ends, enclosed in bracts, indehiscent. —Monospecific genus. (Greek: *sicyos* = cucumber + *sperma* = seed).

Sicyosperma gracile A. Gray (thin, slender, in reference to the stems) (Fig. 10M, N). —In shaded areas on slopes, along streams, and in canyons: Cochise, Gila, Graham, Pima, Pinal, Santa Cruz cos.; 1150–1850 m (3500–5500 ft) (Fig. 3D); Aug–Oct; Mex. (n Son.).

Tumamoca Rose Tumamoc Globeberry

Perennial vines from a cluster of shallow tuberous roots, united into a short woody crown, monoecious. STEMS climbing, woody at base, the stems annual above, delicate, 0.5–1 mm in diameter, sulcate, glabrous. TENDRILS simple. LEAVES with blades deeply and narrowly pedate, the upper surfaces glabrous, the lower surfaces sparsely to densely strigose, with hairs often from prominent crystalline bases, the lobes spreading, variously and irregularly lobulate, acute to obtuse at tip, the central lobe to 60 mm long. STAMINATE flowers in racemes of 6–15 flowers from leaf axils; hypanthium narrowly funnel-shaped, 6.5–11.5 mm long; calyx lobes lanceolate, 0.5–1 mm long; corolla yellow or greenish-yellow, the lobes entire, linear-lanceolate, acute at apex, 3.5–9 mm long, glabrous; stamens 3. PISTILLATE flowers solitary, often in same leaf axils as staminate flowers; hypanthium narrowly tubular, 5–10 mm long; sepals 1 mm long; corolla yellow or greenish yellow, the lobes entire, linear-lanceolate, acute at apex, 3–4 mm long, glabrous; style 1 with 3 stigmas. FRUITS red at maturity, berries, spherical to ovoid, 8–12 mm in diameter; seeds light to dark brown to black, 1–9, arillate, obovoid, compressed, 5–8 mm long, 3.2–5 mm wide, 2–3 mm thick, narrowed at base, often truncate at apex, lateral faces tuberculate-rugose, often prominently so, without a differentiated margin. —2 spp. (1 in AZ); Mex. (Son., n

Zac.). (for Tumamoc Hill, the Amerindian name of the hill which is the former site of the Carnegie Institute Desert Laboratory which now houses the University of Arizona Palynological Laboratory and the U. S. Geological Survey.)

Description augmented with data from Rose (1912) and Kearns (1994b).

Tumamoca macdougalii Rose (for Daniel Trembly MacDougal, 1865–1958, plant physiologist and founder of the Carnegie Desert Laboratory and collector of the type specimen from Tumamoc Hill.) (Fig. 7B, 10I). —On sandy, gravelly, or clay loams of valley bottoms, often adjacent to tributaries or on rocky soils of upper bajadas in association with Sonoran desertscrub and semidesert grassland with *Larrea*, *Parkinsonia*, *Prosopis*, and *Atriplex*: Pima Co. (Fig. 4B); additional sightings in Pinal Co. according to SEINET Sonoran Atlas Collection Statistics; 550–800 m (1600–2700 ft); May–Nov; Mex. (Son.).

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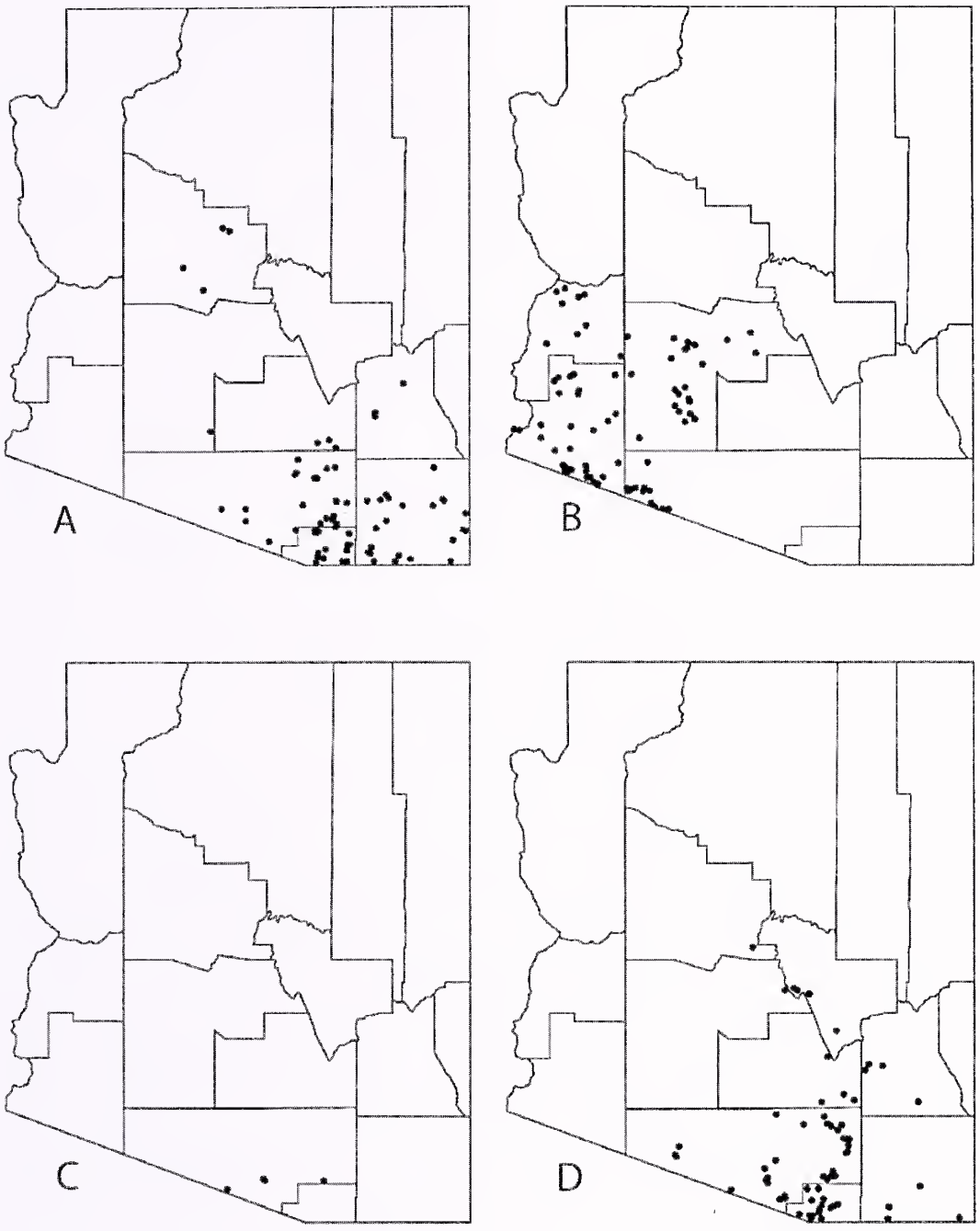
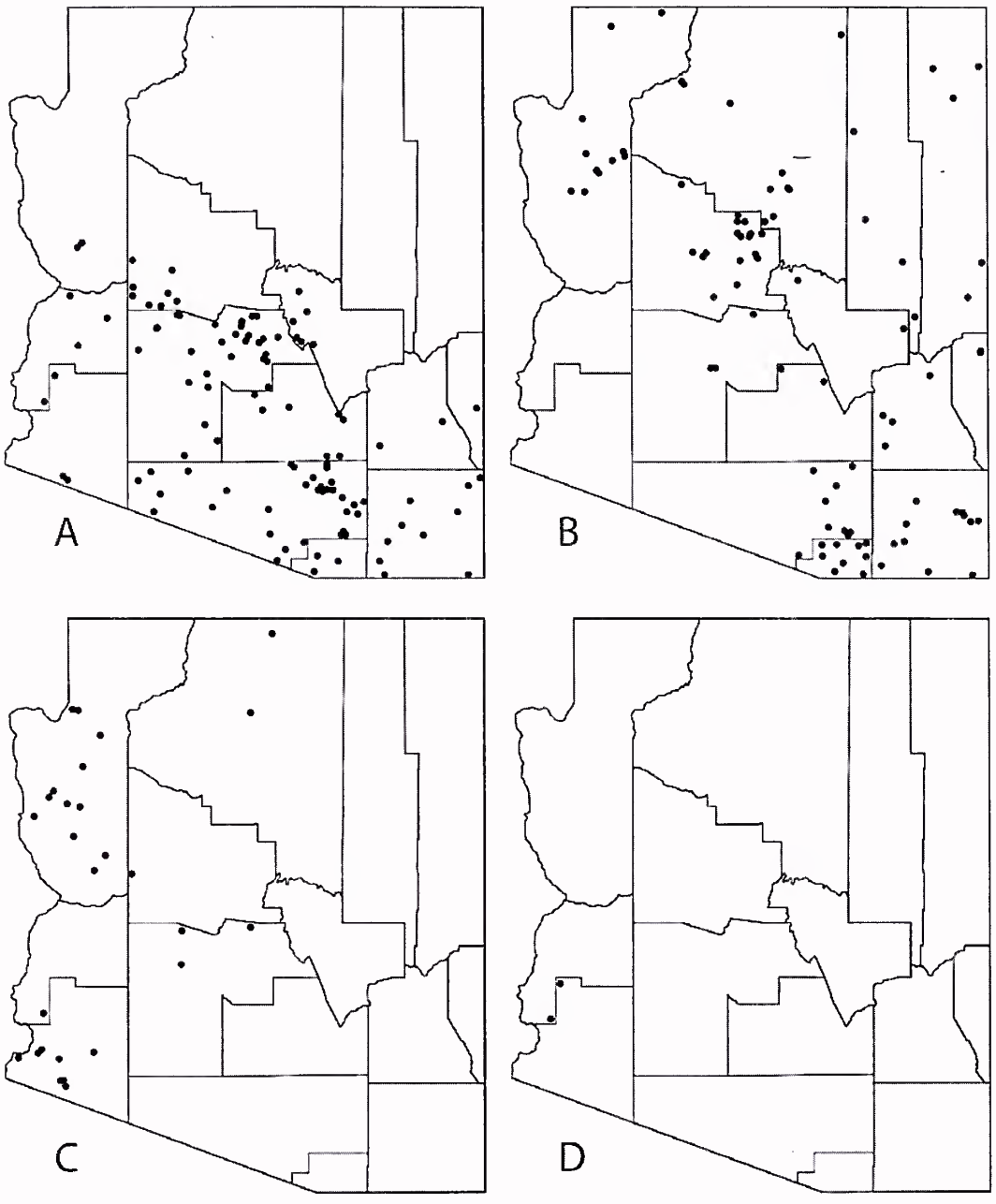
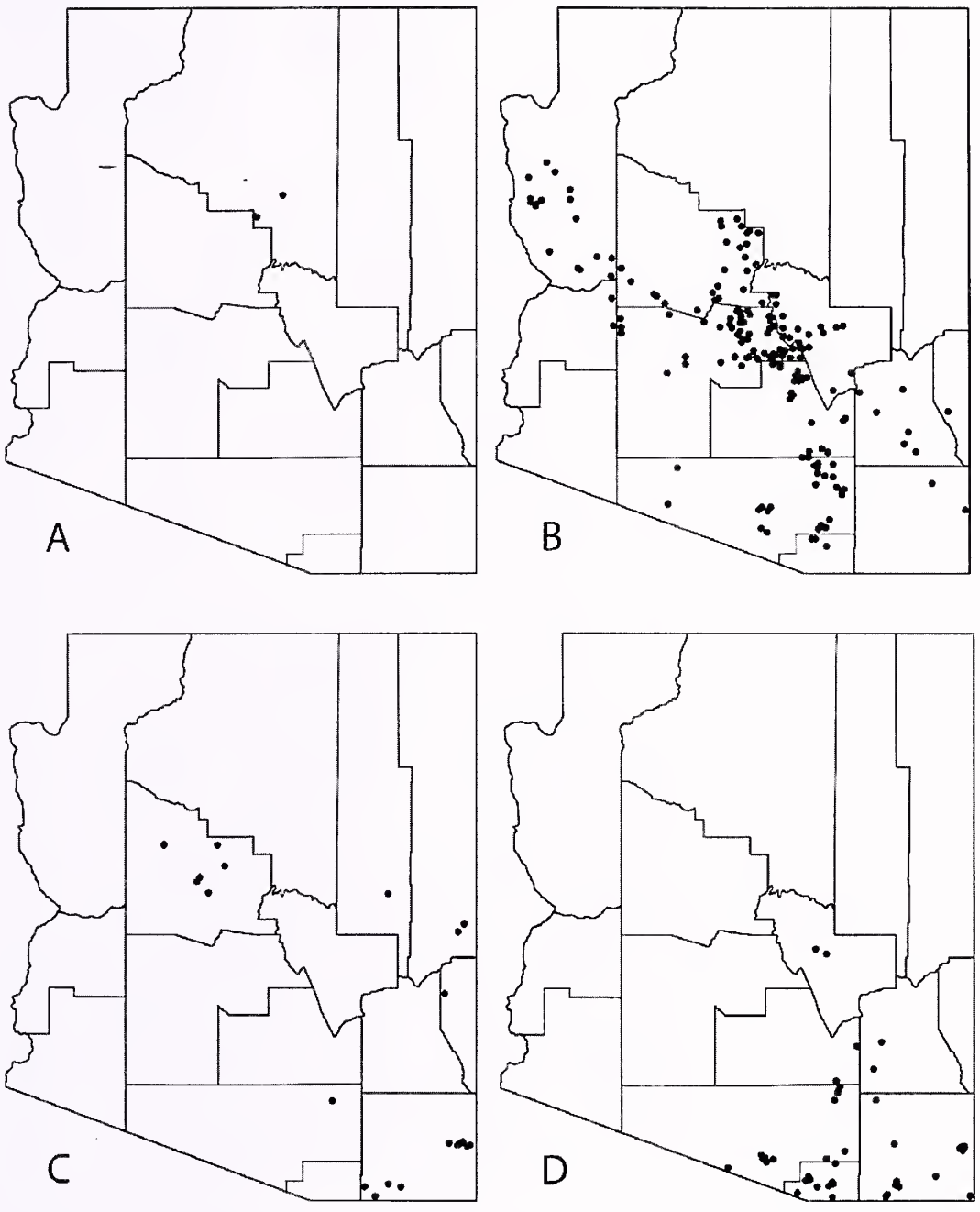


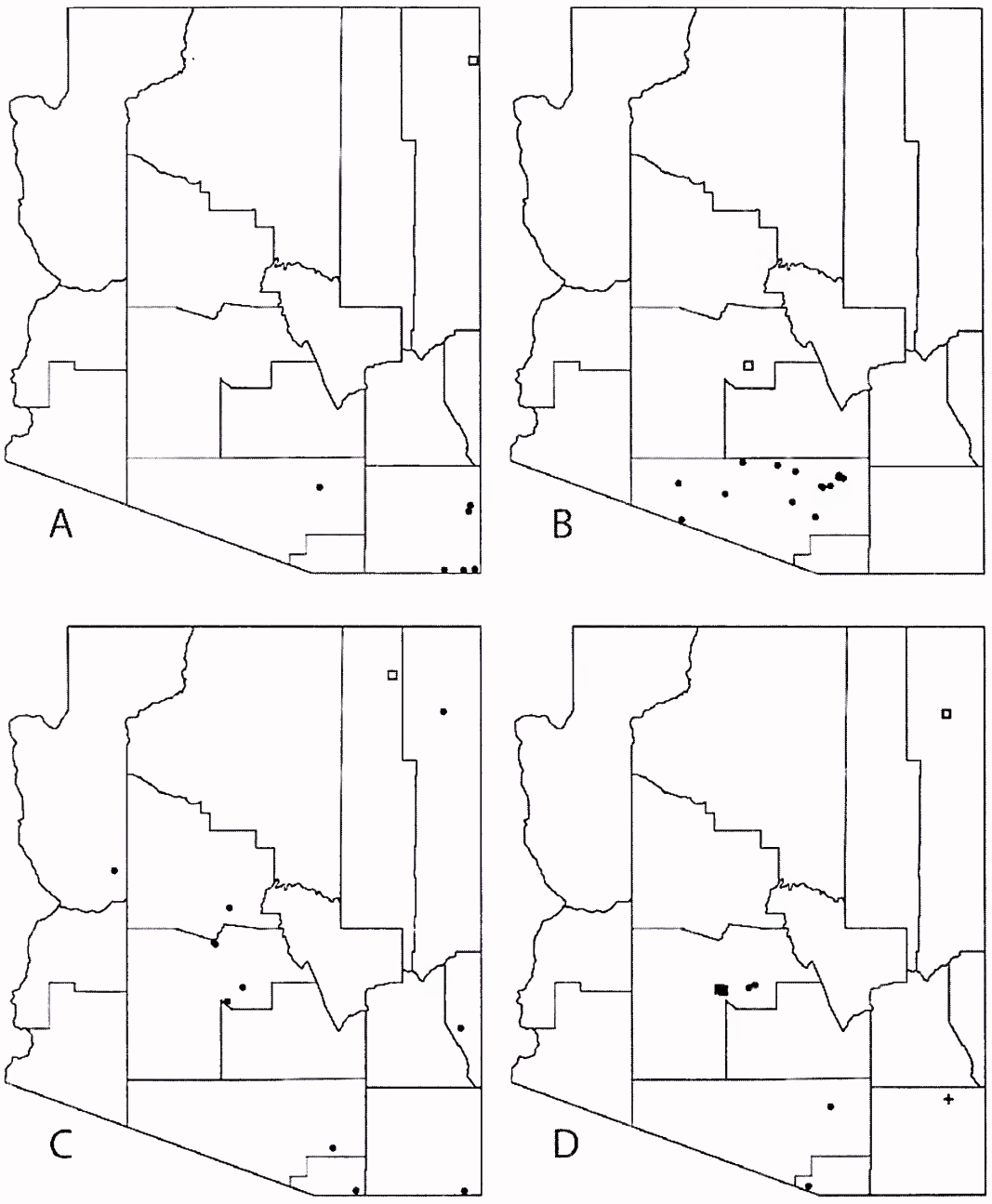
Cucurbitaceae. Figure 1. Distributions of: (A) *Apodanthera undulata* var. *undulata*; (B) *Brandegea bigelovii*; (C) *Cyclanthera gracillima*; (D) *Echinopepon wrightii*.



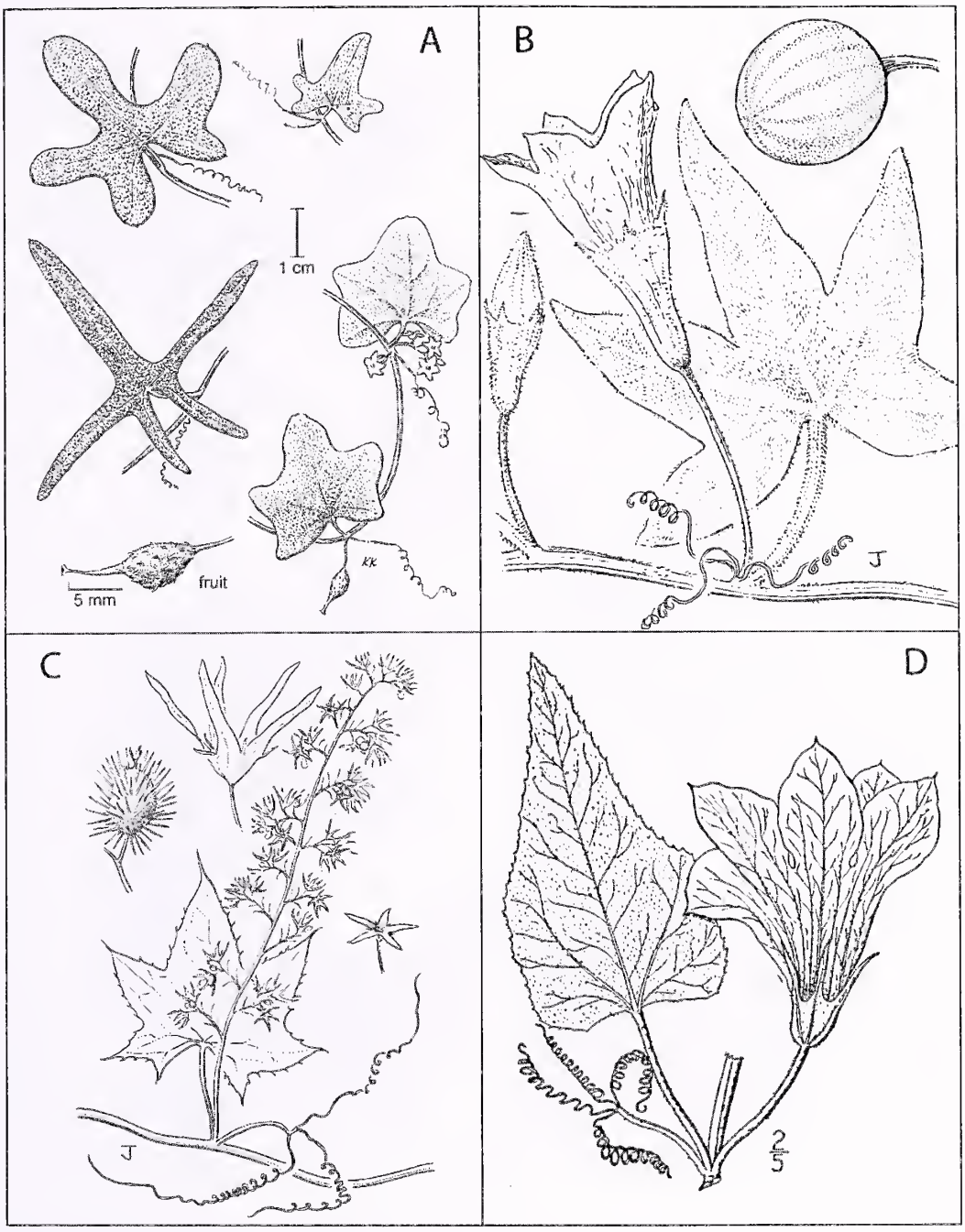
Cucurbitaceae. Figure 2. Distributions of: (A) *Cucurbita digitata*; (B) *Cucurbita foetidissima*; (C) *Cucurbita palmata*; (D) *Cucurbita digitata* × *C. palmata*.



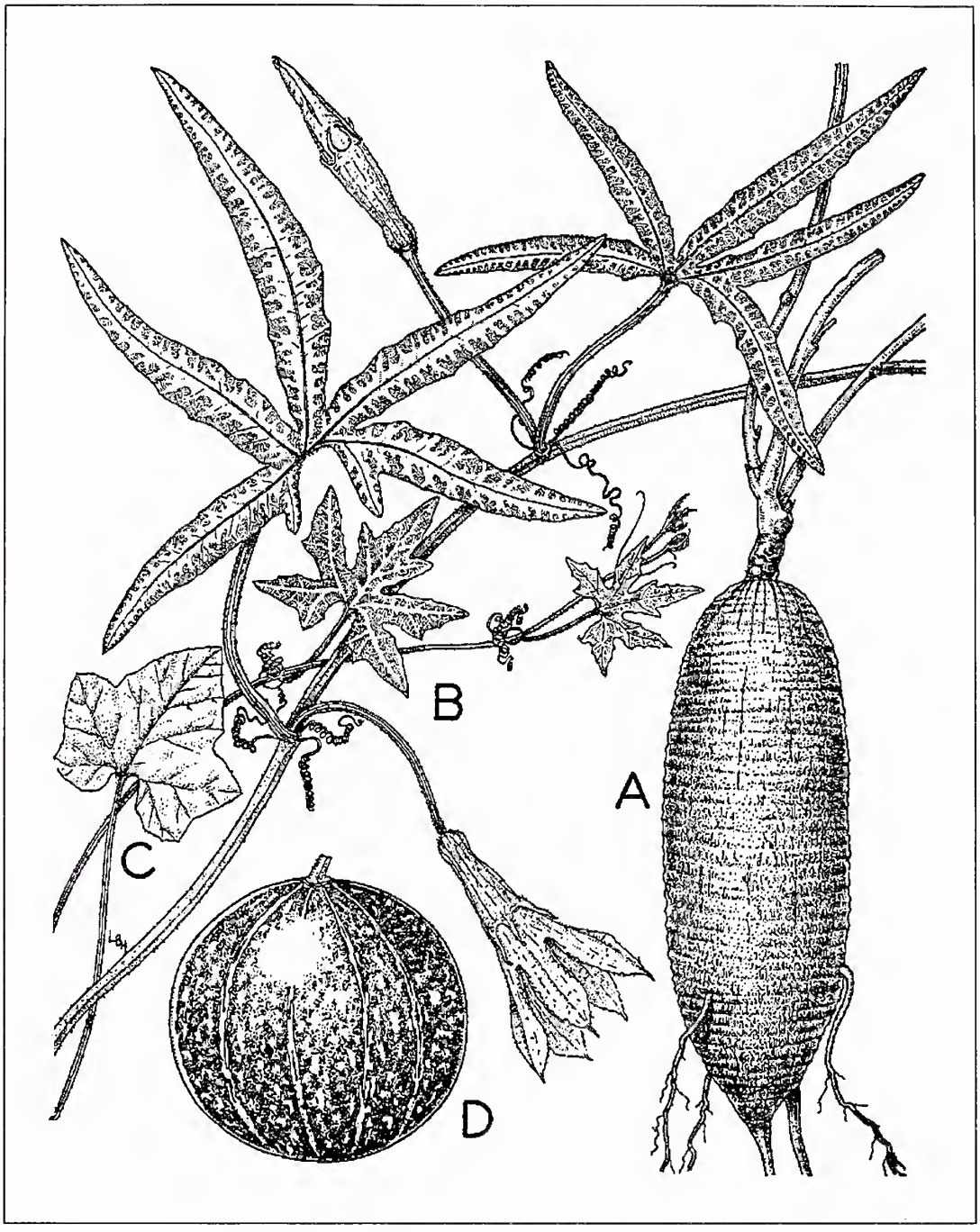
Cucurbitaceae. Figure 3. Distributions of: (A) *Echinocystis lobata*; (B) *Marah gilensis*; (C) *Sicyos laciniatus*; (D) *Sicyosperma gracile*.



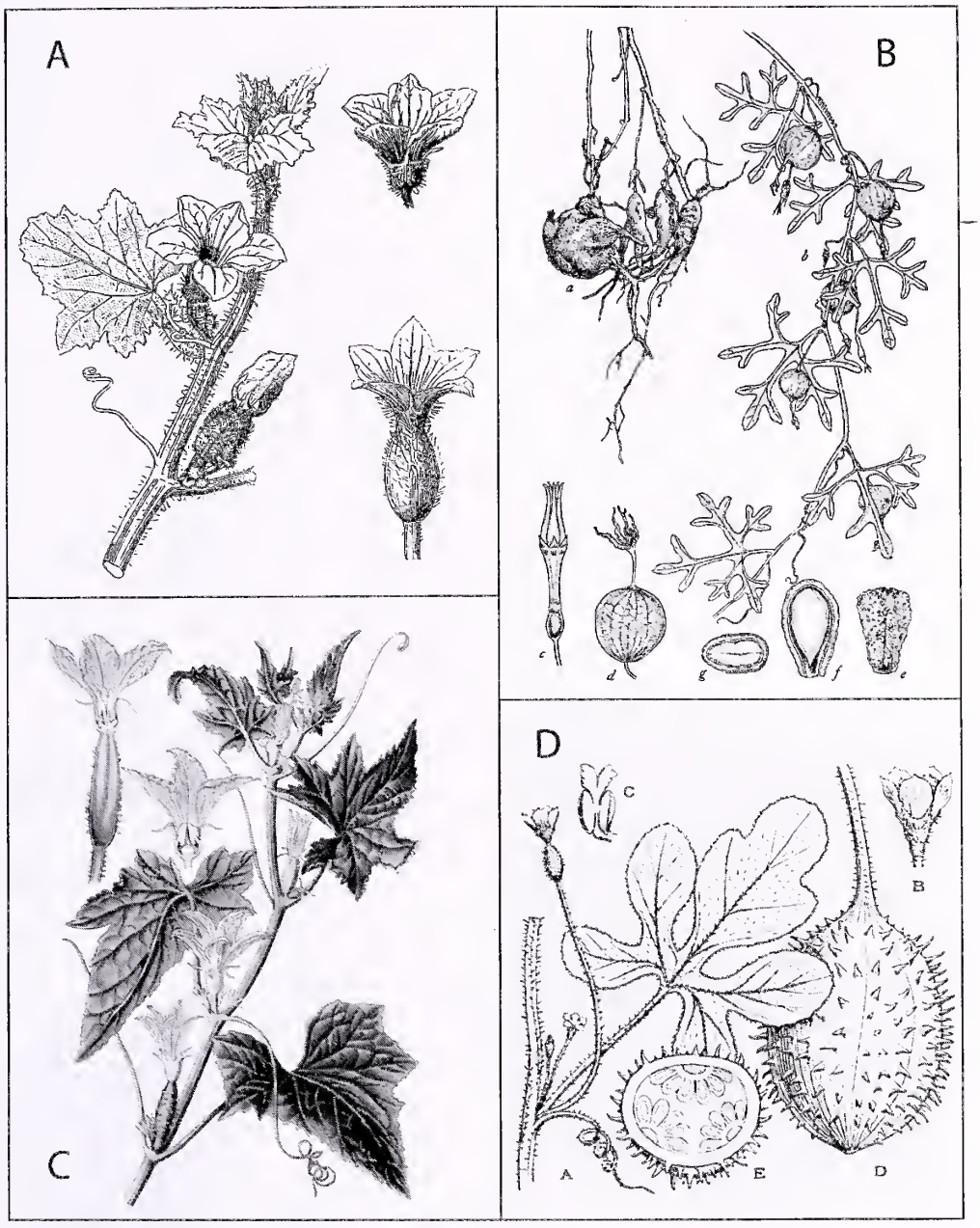
Cucurbitaceae. Figure 4. Distributions of: (A) *Ibervillea tenuisecta* (solid dots) and *Cucurbita maxima* (open square); (B) *Tumamoca macdougalii* (solid dots) and *Lagenaria siceraria* (open square); (C) *Citrullus lanatus* (solid dots) and *Cucurbita pepo* (open square); (D) *Cucumis anguria* (plus sign), *Cucumis melo* (solid dots), *Cucumis sativus* (closed square), and *Cucurbita moschata* (open square).



Cucurbitaceae. Figure 5. (A) *Brandegea bigelovii*: various leaf shapes; stem with tendril, staminate inflorescence, and pistillate flower; fruit in lower left. (B) *Cucurbita palmata*: stem with tendril, leaf, and staminate flower; pepo. (C) *Echinocystis lobata*: stem with tendril, leaf, and staminate inflorescence; individual staminate flower; prickly fruit. (D) *Cucurbita foetidissima* (as *Pepo foetidissima*): stem with tendril, leaf, and staminate flower. (A) reproduced with permission from Baldwin et al. (2012), drawn by Karen Klitz; (B)(C) reproduced with permission from Abrams and Ferris (1960), drawn by Jeanne Russell Janish; (D) reproduced with permission from Britton and Brown (1913).

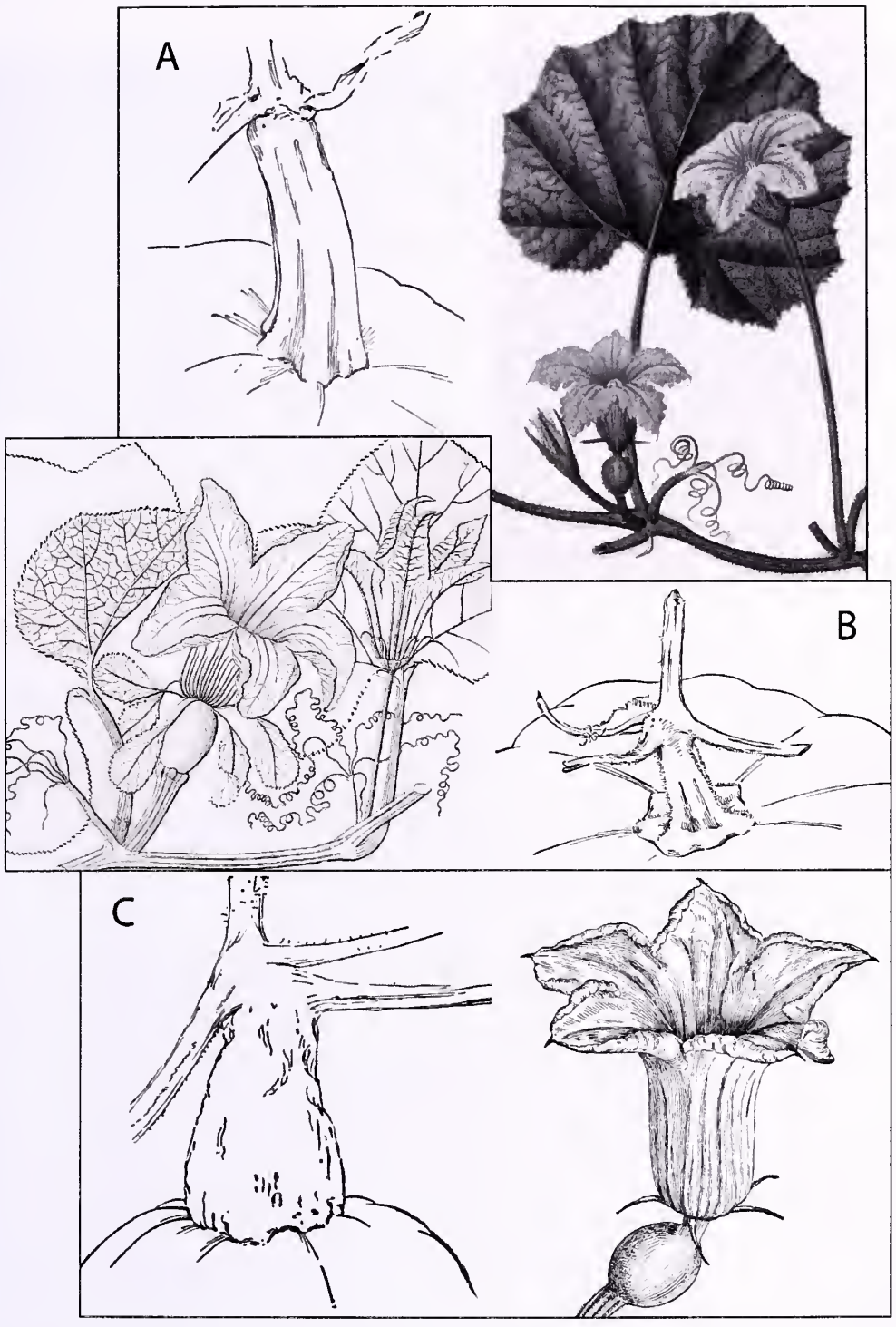


Cucurbitaceae. Figure 6. *Cucurbita digitata*: *a*, root; *b*, stem with tendrils, leaves, and two staminate flowers; *c*, juvenile leaf; *d*, fruit. Reproduced with permission from Parker (1958), drawn by Lucretia Breseale Hamilton.



Cucurbitaceae. Figure 7. (A) *Cucumis melo*: stem with tendril, leaf, and pistillate flower; staminate flower upper right; pistillate flower lower right. (B) *Tumamoca macdougalii*: *a*, roots; *b*, stem with leaves and fruits; *c*, staminate flower; *d*, pistillate flower; *e–g*, seed. (C) *Cucumis sativus*: stem with tendril, leaf, pistillate flower in lowest leaf axil, and staminate flower in next leaf axil up; vertical cross-sections of pistillate flower (upper left) and staminate flower (center). (D) *Cucumis anguria*: a, stem with tendril, leaf, raceme of staminate flowers, and solitary pistillate flower; *b*, staminate flower; *c*, anther with appendage; *d*, prickly fruit; *e*, horizontal cross-section of fruit. (A) reproduced from LeMaout and Decaisne (1873); (B) reproduced from Rose (1912); (C) reproduced from Masclef (1891); (D) reproduced from Faucett and Rendle (1926). See Lit. cited.

Cucurbitaceae. Figure 8. (A) *Lagenaria siceraria*: *a*, stem with tendril, leaves, and two flowers; *b*, staminate flower (inset of anthers); *c*, leaf bases with petiolar glands; *d*, pistillate flowers; *e*, stigmas; *f* and *g*, two fruits; *h* two views of seeds. (B) *Citrullus lanatus*: stem with tendril and pinnately-lobed leaves; staminate flower (upper left); pistillate flower (upper right); fruit (far right). (A) reproduced with permission from Dieterle (1976), drawn by M. Pahl; (B) reproduced from Nicholson (1884).



Cucurbitaceae. Figure 9. (A) *Cucurbita pepo*, pedicel in fruit on left; stem on right with leaf, pistillate flower (left) and staminate flower (right). (B) *Cucurbita moschata*, stem with leaves and pistillate flower with expanded calyx lobes (left); pedicel in fruit (right). (C) *Cucurbita maxima*, pedicel in fruit (left); pistillate flower with narrow calyx lobes (right). (A) and (B) pedicels in fruit reproduced from Bailey (1909); (A) stem reproduced from Chaumeton et al. (1830); (B) stem reproduced from Kirtikar and Basu (1918; as *Cucurbita maxima*); (C) reproduced from Bailey (1909).

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Cucurbitaceae. Figure 10. Images of: (A) *Apodanthera undulata* var. *undulata*; (B) *Apodanthera undulata* var. *undulata*; (C) *Cyclanthera gracillima*; (D) *Brandegea bigelovii*; (E) *Cucurbita palmata*; (F) *Cucurbita foetidissima*; (G) *Ibervillea tenuisecta*; (H) *Ibervillea tenuisecta*; (I) *Tumamoca macdougalii*; (J) *Sicyos laciniatus*; (K) *Echinopepon wrightii*; (L) *Echinopepon wrightii*; (M) *Sicyosperma gracile*; (N) *Sicyosperma gracile*; (O) *Marah gilensis*. Photos (A), (E), (N), and (O) by T. Daniel; (B), (F), (J) by M. Licher; (C) by F. Coburn; (D) by K. Morse; (G) by R. Sivinski; (H) by P. Alexander; (I) by M. Butterwick; (J) by J. Fonseca; (L) by M. Baker; (M) by J. Cowles.

NEW RECORDS FOR THE FLORA OF ARIZONA

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ARALIACEAE

Hydrocotyle umbellata L., commonly known as Manyflower Marsh Pennywort, is an aquatic emergent that grows in slow moving water, marshes, ponds, and in some regions, lawns. The genus *Hydrocotyle* was previously included in Apiaceae, but is now placed in Araliaceae under the 2016 Angiosperm Phylogeny Group IV system (APG IV 2016). We recently discovered numerous populations growing in ditches and ponds at the City of Phoenix Tres Rios Wetlands, a managed wetland project that incorporates treated effluent released from the nearby 91st Avenue Wastewater Treatment Plant (City of Phoenix 2016, US Army Corps of Engineers 2010).

Previously collected specimens near this site and at the City of Phoenix Rio Salado Habitat Restoration Area Demonstration Wetlands, about ten miles east of Tres Rios, were incorrectly identified as *H. verticillata* by Poznik in 2003, Jenke in 2007, and Olmon in 2009 (*Poznik 8, Jenke 53, Olmon 31,* all at ASU). Both *H. umbellata* and *H. verticillata* have round, glossy, peltate leaves with shallowly crenate edges attached to a long petiole, but the differing types of inflorescences easily distinguish the two species: *H. umbellata* flowers are arranged in one simple umbel, while *H. verticillata* bears verticils, or several small whorls of flowers arranged along the inflorescence axis (Fig. 1). The plants spread from submerged stolons rooted in mud to create extensive floating mats along edges of ponds at Tres Rios Wetlands. Confusion about the identity of this Pennywort probably occurred because *H. umbellata* would match the characters in the key and description for *H. verticillata* using our primary botanical reference for Arizona, Arizona Flora (Kearney and Peebles 1960), while *H. umbellata* is not treated in the key.

These are the first collections of *Hydrocotyle umbellata* in Arizona, although it is broadly established in southern California and Texas, as well as throughout the eastern United States up to Nova Scotia, Canada (USDA NRCS 2016, Brouillet et al. 2010). It is possible that *H. umbellata* has somehow been overlooked until now, since natural distribution would be unlikely to "skip" wetlands in Arizona and New Mexico,

New Records for the Flora of Arizona. *Canotia* 12:86-89. 2016. ©K. Darrow and E. Makings.

especially given that dispersal is facilitated by migratory birds. We speculate that *H. umbellata* was unintentionally introduced during the Tres Rios Wetlands restoration projects since all collections have been found post-construction near the Salt River/Gila River confluence.

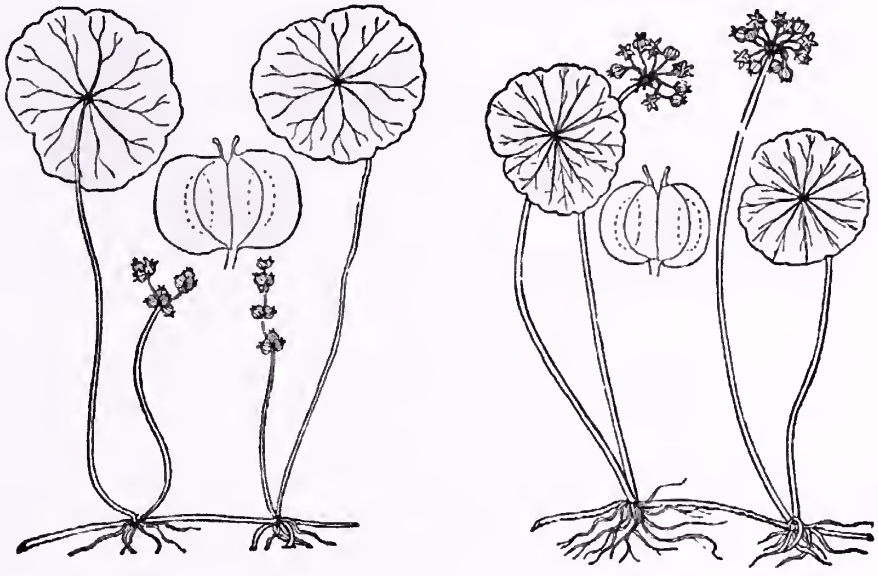

Figure 1. Left: *Hydrocotyle verticillata* with verticillate inflorescences. Right: *H. umbellata* with umbel inflorescences. From Britton & Brown. 1936. An Illustrated Flora of the Northern United States, Canada and the British Possessions. Vol. II. Second Edition. Lancaster Press, Inc. Laneaster, PA.

CRASSULACEAE

Bryophyllum daigremontianum (Raym.-Hamet & H. Perrier) A. Berger, a succulent plant native to Madagascar, is a common ornamental in the horticultural trade. Folk names include "Kalanchoe," "Alligator Plant," "Devil's Backbone," and "Mexican Hat Plant," but "Mother-of-thousands" may be the most common colloquial reference because of the vegetatively produced plantlets that sprout along the edge of the leaves. In Arizona, specimens have been documented from what appear to be cultivated plants only.

Our new record (*Darrow 1202*, ASU) documents what appears to be a feral population in the common area of an apartment complex in Tempe, found while conducting surveys for the Central Arizona Phoenix Long Term Ecological Research Survey 200 program (CAP-LTER Survey 200) (CAP-LTER 2016). This record is significant because the species is known to easily escape from cultivation, and has thus become naturalized in tropical and subtropical regions, including southern Florida, Hawaii and Western Australia (USDA NRCS 2016, New South Wales Government Department of Primary Industries 2015). Although it is not frost tolerant, it is well-adapted to drought conditions. Our record is likely one of several small populations in the urban area, or a nucleus from which it could spread. Local master gardener, Deborah Sparrow (personal communication) verifies that *Bryophyllum daigremontianum* is commonly traded and planted throughout the urban area, especially around Tempe, and is established in our urban climate where it has sufficient shade and appropriate microclimate.

MALVACEAE

Malvastrum coromandelianum (L.) Garcke, commonly known as Threelobe False Mallow, is regarded as a pantropical weed, having spread from its origins in central South America to warm climates on all continents except for Antarctica (Hill 1982). In the U.S., collections have been documented for several southeastern and northeastern states, as well as Hawaii, but the first known record for Arizona was collected in April 2015 while conducting surveys for the CAP-LTER Survey 200 (*Darrow 1200*, ASU). We discovered sprawling, procumbent mats of this suffrutescent perennial volunteering in a non-irrigated lawn in central Phoenix on the property of a private school. Specimens were also collected in fruit and flower in July of 2015 (*Boydston & Holland s.n.,* ASU). There are possibly other populations of this plant throughout the metropolitan area, since it is well adapted to disturbance and is known as a "yard weed," however, none were found during a subsequent search of adjacent irrigated lawns on the same property in February of 2016.

Malvastrum coromandelianum is similar to a closely related species found in southern Arizona and Mexico, *M. bicuspidatum*. *Malvastrum coromandelianum* can be distinguished by the mostly simple hairs concentrated on the veins of the ventral surface of the leaves. In contrast, *M. bicuspidatum* has scattered stellate hairs on the underside of the leaves (Fig. 2). The shape and ornamentation of the mericarps is also distinctive: *M. coromandelianum*'s mericarps have a slender apical spur, or cusp, in addition to two distal cusps, hence the common name "Threelobe," referring to the cusps. *Malvastrum coromandelianum* also has numerous stiff erect hairs along the apical portion of the mericarps. The mericarps of *M. bicuspidatum* have fewer and shorter apical hairs and no apical cusp. The prostrate habit, flowers, and leaves of *M. coromandelianum* also superficially resemble another weedy Malvaceae, *Sida abutifolia* P. Mill.

Malvastrum coromandelianum is a cosmopolitan species and sometimes an agricultural invasive, whereas, in Arizona, *M. bicuspidatum* is restricted to canyons of only a few mountain ranges in the central and southern part of the state (SEINet 2016). The similarities make for an interesting case study in how and why certain species become more widespread after human-caused introduction.

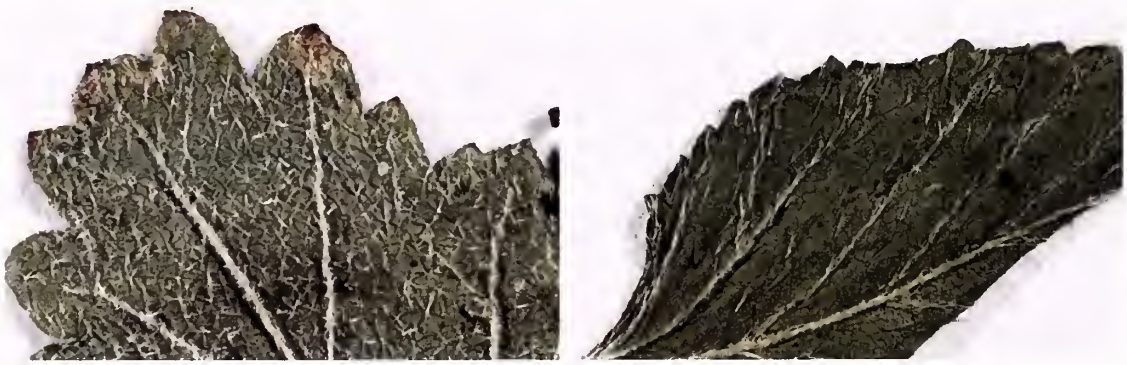

Figure 2. A comparison of leaf vestiture of *Malvastrum bicuspidatum* (left) and *M. coromandelianum* (right). Note scattered branching hairs of *M. bicuspidatum* and simple hairs mostly along veins of *M. coromandelianum.*

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INDEX TO FAMILIES OF THE VASCULAR PLANTS OF ARIZONA

Published treatments (**in bold**) can be found in volumes 26, 27, 29, 30, 32, 33, and 35 of the *Journal of the Arizona-Nevada Academy of Science* (**JANAS**) or in subsequent volumes (1–12) of **CANOTIA**. Unbolded entries indicate families with no treatments published to date. Figure numbers refer to illustrations in the "Key to Families of Vascular Plants in Arizona" in **JANAS** 35(2). All Vascular Plants of Arizona treatments are available as pdf files online (http://www.canotia.org/vpa_project.html).

Acanthaceae CANOTIA 12:22-54. 2016. (T. Daniel)
Aceraceae JANAS 29(1):2. 1995. (L.R. Landrum)
Adiantaceae (Fig. 1)
Agavaceae Part 1: *Agave* JANAS 32(1):1. 1999. (W. Hodgson)
Aizoaceae Alismataceae Amaranthaceae (Fig. 4)
Anacardiaceae CANOTIA 3(2):13. 2007. (J.L. Anderson)
Apiaceae (Fig. 5)
Apocynaceae JANAS 27(2):164. 1994. (S.P. McLaughlin)
Araceae
Araliaceae
Arecaceae JANAS 32(1):22. 1999. (C.T. Mason, Jr.)
Aristolochiaceae JANAS 32(1):24. 1999. (C.T. Mason, Jr.)
Asclepiadaceae JANAS 27(2):169. 1994. (E. Sundell)
Aspleniaceae
Asteraceae (Figs. 6–7)
Azollaceae CANOTIA 4(2):31. 2008. (G. Yatskievych and M.D. Windham)
Berberidaceae JANAS 26(1):2. 1992. (J.E. LaFerriere; Fig. 9)
Betulaceae JANAS 33(1):1. 2001. (J.W. Brasher)
Bignoniaceae JANAS 32(1):26. 1999. (C.T. Mason, Jr.)
Bixaceae JANAS 27(2):188. 1994. (W. Hodgson)
Blechnaceae CANOTIA 4(2):35. 2008. (G. Yatskievych and M.D. Windham; Fig. 1)
Boraginaceae (Fig. 9)
Brassicaceae
Bromeliaceae CANOTIA 3(2):23. 2007. (R. Gutierrez, Jr.)
Buddlejaceae JANAS 26(1):5. 1992. (E.M. Norman)
Burseraceae JANAS 32(1):29. 1999. (A. Salywon)
Cactaceae Part One: The Cereoid Cacti JANAS 29(1):6. 1995. (D.J. Pinkava)
Cactaceae Part Two: *Echinocactus* JANAS 29(1):13. 1995. (M. Chamberland)
Cactaceae Part Three: *Cylindropuntia* JANAS 32(1):32. 1999. (D.J. Pinkava)
Cactaceae Part Four: *Grusonia* JANAS 32(1):48. 1999. (D.J. Pinkava)
Cactaceae Part Five: *Pediocactus* and *Sclerocactus* JANAS 33(1):9. 2001. (K.D. Heil and J.M. Porter)
Cactaceae Part Six: *Opuntia* JANAS 35(2):137. 2003. (D.J. Pinkava).
Callitrichaceae JANAS 29(1):15. 1995. (J. Ricketson)
Campanulaceae
Cannabaceae JANAS 32(1):53. 1999. (C.T. Mason, Jr.)
Capparaceae (Fig. 8)
Caprifoliaceae (Fig. 10)
Caryophyllaceae (Fig. 10)
Celastraceae JANAS 30(2):57. 1998. (J.W. Brasher)
Ceratophyllaceae JANAS 29(1):17. 1995. (J. Ricketson)
Chenopodiaceae (Fig. 9)
Clusiaceae
Commelinaceae JANAS 33(1):19. 2001. (R. Puente and R. Faden)
Convolvulaceae JANAS 30(2):61. 1998. (D.F. Austin)
Cornaceae
Crassulaceae JANAS 27(2):190. 1994. (R. Moran)
Crossosomataceae JANAS 26(1):7. 1992. (C. Mason)
Cucurbitaceae CANOTIA 12:55-85. 2016. (M. Butterwick)
Cupressaceae JANAS 27(2):195. 1994. (J. Bartel)
Cuscutaceae
Cyperaceae Part One: Key to the Genera and *Carex*. CANOTIA 11(1):1. 2015. (G. Rink and M. Licher)
Dennstaedtiaceae CANOTIA 4(2):38. 2008. (G. Yatskievych and M.D. Windham; Fig. 1)
Dipsaceae JANAS 27(2):201. 1994. (J.E. LaFerriere)
Dryopteridaceae (Fig. 1)
Elaeagnaceae
Elatinaceae
Ephedraceae (Fig. 2)
Ericaceae CANOTIA 4(2):21. 2008. (J.L. Anderson; Fig. 11)
Euphorbiaceae Part One: *Acalypha* and *Cnidoscolus* JANAS 29(1):18. 1995. (G.A. Levin)
Equisetaceae CANOTIA 4(2):41. 2008. (G. Yatskievych and M.D. Windham)
Fabaceae Part One: *Errazuria*, *Marina*, *Parryella*, and *Psorothamnus* CANOTIA 7:1. 2011 (S. Rhodes, J. Beasley, and T. Ayers; Figs. 12–13)
Fagaceae JANAS 27(2):203. 1994. (L.R. Landrum)
Fouquieriaceae JANAS 32(1):55. 1999. (C.T. Mason, Jr.)
Fumariaceae JANAS 33(1):27. 2001. (S. Holiday and A. Perez)
Garryaceae JANAS 33(1):31. 2001. (R. Puente and T.F. Daniel)
Gentianaceae JANAS 30(2):84. 1998. (C.T. Mason, Jr.)
Geraniaceae (Fig. 14)
Grossulariaceae
Haloragaceae
Hippuridaceae JANAS 29(1):25. 1995. (J. Ricketson)
Hydrangeaceae
Hydrocharitaceae
Hydrophyllaceae (Fig. 14)
Iridaceae Part One: *Sisyrinchium* JANAS 27(2):215. 1994. (A.F. Cholewa and D.M. Henderson)
Iridaceae Part Two: *Iris* and *Nemastylis* JANAS 33(1):35. 2001. (C.T. Mason, Jr.)
Isoëtaceae CANOTIA 5(1):27. 2009. (G. Yatskievych and M.D. Windham)
Juglandaceae JANAS 27(2):219. 1994. (J.E. LaFerriere)
Juncaceae (Fig. 19)
Juncaginaceae
Key to Families of Vascular Plants in Arizona JANAS 35(2):88. 2003. (D.J. Keil)
Krameriaceae JANAS 32(1):57. 1999. (B.B. Simpson and A. Salywon)

Lamiaceae Part One: *Agastache, Hyptis, Lamium, Leonurus, Marrubium, Monarda, Monardella, Nepeta, Salazaria, Stachys, Teucrium, and Trichostema* JANAS 35(2):151. 2003. (C.M. Christy, D.Z. Damrel, A. Henry, A. Trauth- Nare, R. Puente-Martinez, and G. Walters)
Lemnaceae JANAS 26(1):10. 1992. (E. Landolt)
Lennoaceae JANAS 27(2):220. 1994. (G. Yatskievych)
Lentibulariaceae CANOTIA 8(2):54-58. 2012. (B. Rice)
Liliaceae (Fig. 19)
Linaceae
Loasaceae JANAS 30(2):96. 1998. (C.M. Christy)
Lythraceae
Malpighiaceae
Malvaceae Part One: All genera except *Sphaeralcea*. JANAS 27(2):222. 1994. (P.A. Fryxell)
Marsileaceae CANOTIA 5(1):30. 2009. (G. Yatskievych and M.D. Windham)
Martyniaceae CANOTIA 3(2):26. 2007. (R. Gutierrez, Jr.)
Meliaceae
Menispermaceae JANAS 27(2):237. 1994. (J.E. LaFerriere)
Menyanthaceae JANAS 33(1):38. 2001. (C.T. Mason, Jr.)
Monotropaceae JANAS 26(1):15. 1992. (E. Haber)
Molluginaceae JANAS 30(2):112. 1998. (C.M. Christy)
Moraceae
Najadaceae
Nyctaginaceae (Fig. 14)
Nymphaeaceae JANAS 29(1):26. 1995. (J. Ricketson)
Oleaceae (Fig. 15)
Onagraceae (Fig. 15)
Ophioglossaceae
Orchidaceae
Orobanchaceae
Oxalidaceae JANAS 30(2):115. 1998. (R. Ornduff and M. Denton)
Papaveraceae JANAS 30(2):120. 1998. (G.B. Ownbey with contributions by J.W. Brasher and C. Clark)
Passifloraceae JANAS 33(1):41. 2001. (J.M. MacDougal)
Phrymaceae CANOTIA 12:1-21. 2016. (K. Hansen, E. Johnson, K.O. Phillips, J. Talboom and T. Ayers)
Phytolaccaceae JANAS 33(1):46. 2001. (V. Steinmann)
Pinaceae
Plantaginaceae JANAS 32(1):62. 1999. (K.D. Huisinga and T.J. Ayers)
Platanaceae JANAS 27(2):238. 1994. (J.E. LaFerriere)
Plumbaginaceae
Poaceae (Fig. 20)
Polemoniaceae CANOTIA 1:1. 2005. (D. Wilken and M. Porter)
Polygalaceae
Polygonaceae (Fig. 15)
Polypodiaceae CANOTIA 5(1):34. 2009. (G. Yatskievych and M.D. Windham; Fig. 1)
Pontederiaceae JANAS 30(2):133. 1998. (C.N. Horn)
Portulacaceae CANOTIA 2(1):1. 2006. (A. Bair, M. Howe, D. Roth, R. Taylor, T. Ayers, and R.W. Kiger)
Potamogetonaceae
Primulaceae JANAS 26(1):17. 1992. (A.F. Cholewa; Fig. 16)
Psilotaceae CANOTIA 3(2):32. 2007. (R. Gutierrez, Jr.)
Pyrolaceae JANAS 26(1):22. 1992. (E. Haber)
Rafflesiaceae JANAS 27(2):239. 1994. (G. Yatskievych)
Ranunculaceae (Fig.15)
Resedaceae
Rhamnaceae CANOTIA 2(1):23. 2006. (K. Christie, M. Currie, L. Smith Davis, M-E. Hill, S. Neal, and T. Ayers)
Rosaceae Part One: *Rubus*. JANAS 33(1):50. 2001. (J.W. Brasher)
Rubiaceae JANAS 29(1):29. 1995. (L. Dempster and E.T. Terrell; Fig. 16)
Ruppiaceae
Rutaceae
Salicaceae Part One: *Populus*. JANAS 26(1):29. 1992. (J.E. Eckenwalder)
Salicaceae Part Two. *Salix*. JANAS 29(1):39. 1995. (G.W. Argus)
Salviniaceae CANOTIA 4(2):50. 2008. (G. Yatskievych and M.D. Windham)
Santalaceae JANAS 27(2):240. 1994. (J.E. LaFerriere)
Sapindaceae JANAS 32(1):76. 1999. (A. Salywon)
Sapotaceae JANAS 26(1):34. 1992. (L.R. Landrum)
Saururaceae JANAS 32(1):83. 1999. (C.T. Mason, Jr.)
Saxifragaceae JANAS 26(1):36. 1992. (P. Elvander; Fig. 16)
Scrophulariaceae (Fig. 17) **(see also Phrymaceae)**
Selaginellaceae CANOTIA 5(1):39. 2009. (G. Yatskievych and M.D. Windham)
Simaroubaceae JANAS 32(1):85. 1999. (J.W. Brasher)
Simmondsiaceae JANAS 29(1):63. 1995. (J. Rebman)
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Solanaceae Part Two: Key to the Genera and *Solanum*. CANOTIA 5(1):1. 2009. (S.T. Bates, F. Farruggia, E. Gilbert R. Gutierrez, D. Jenke, E. Makings, E. Manton, D. Newton, and L.R. Landrum)
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Sparganiaceae JANAS 33(1):65. 2001. (J. Ricketson)
Sterculiaceae
Tamaricaceae
Thelypteridaceae CANOTIA 5(1):49. 2009. (G. Yatskievych and M.D. Windham)
Tiliaceae
Typhaceae JANAS 33(1):69. 2001. (J. Ricketson)
Ulmaceae JANAS 35(2):170. 2003. (J.W. Brasher)
Urticaceae JANAS 26(1):42. 1992. (D. Boufford)
Valerianaceae
Verbenaceae
Violaceae. JANAS 33(1):73. 2001. (R.J. Little; Fig. 17)
Viscaceae JANAS 27(2):241. 1994. (F.G. Hawksworth and D. Wiens)
Vitaceae
Zannichelliaceae
Zygophyllaceae (Fig. 17)